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Volume 21, Number 13, July 15, 1967

NUCLEAR SCIENCE ABSTRACTS

A semimonthly publication of the USAEC Division of Technical Information, Edward J. Brunenhant, Director. Published by the USAEC Division of Technical Information Extension, Robert L. Shannon, Extension Manager.

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Index References

All index entries refer the reader to volume and abstract number:

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FOURRIER, Alain
  Radioactive chain of mass number 189,  21:10023
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Personal Authors

Every author's name is indexed in the form appearing on the document abstracted:

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MONTH, M.
  Theory of gradient perturbations in AGS,  21:9872 (BNL-
    10899)
MONTH, Melvin
  Simple relativistic calculation of the electromagnetic
    form factors of the deuteron,  21:9744
```

Subjects

The subject index is arranged alphabetically by means of specific materials, objects, and processes. Modifying phrases in turn are alphabetized by important file words.

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SHEEP
  radiation dosimetry in, measurement of lethal dose of x,
    21:8905(R) (AD-631189)
  radiosensitivity of hematopoietic system of, x,
    21:8905(R) (AD-631189)
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SHELTERS
  construction of, for civil defense,  21:8838
  design of fallout,  21:8777(R) (AD-629736)
  design of shaft closure for,  21:8563(R)
  determination of configuration of, for ventilation,
    21:8779(R) (AD-629928)
  equipment for fallout, minimal requirements of,
    21:8782(R) (AD-631424)
  evaluation of fallout, for fire and air blast damage,
    21:8560 (URS-658-3)
  fire resistance of components of, evaluation of,
    21:8789(R) (AD-642241)
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Corporate Authors

Technical report literature is indexed from the name of the organization or institution responsible for the issuance of the report.

8500 (Y-1561) MIXING AND SAMPLING ENRICHED ^{235}U FLUIDS IN CYLINDRICAL STORAGE CONTAINERS. Final Report. Harrell, J. E. **(Union Carbide Corp., Oak Ridge, Tenn. Y-12 Plant).** Jan. 17, 1967. Contract W-7405-eng-26. 124p. Dep. mn. CFSTI $3.00 cy, $0.65 mn.

is indexed as:

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UNION CARBIDE CORP., OAK RIDGE, TENN.  Y-12 PLANT.
  Mixing and sampling enriched 235U fluids in cylindrical
    storage containers,  21:8500 (Y-1561)
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Report Numbers

Technical report literature is also indexed by report numbers. This index includes information on where individual reports may be obtained. While not reports, patents and conference papers are indexed here as a matter of convenience.

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TID-
  3311(Suppl.  21-8567   Dep. mn. CFSTI $3.00 cy, $0.65 mn
    2)
  22298        21-9915   Nucl. News, 9: No. 12, 17-21 (Dec.
                           1966)
  22298        21-9914   Nucl. News, 10: No. 1, 17-20(Jan.
                           1967)
  23267        21-9702   Phys. Rev., 152: 1171-82(Dec. 23,
                           1966)
  23287        21-8498   Dep. mn. CFSTI $3.00 cy, $0.65 mn
  23420        21-8764   Lancet, 2: 672-5(Sept. 24, 1966)
  23474        21-8528   Dep. mn. CFSTI $3.00 cy, $0.65 mn
  23478        21-8641   Dep. mn. CFSTI $3.00 cy, $0.65 mn
  23482        21-9471   Dep. mn. CFSTI $3.00 cy, $0.65 mn
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CHEMISTRY

Analytical Chemistry

Refer also to abstracts 21955, 21963, 22008, and 23740.

21854 (AD-643127) GAMMA RAY SPECTRAL ANALYSIS: A SELECTED BIBLIOGRAPHY. Mason, G. F. (Armed Forces Radiobiology Research Inst., Bethesda, Md.). Sept. 1966. 26p. (AFRRI-SP-66-10). CFSTI $3.00 cy, $0.65 mn.

References that deal with the analysis of gamma spectra by all methods are presented. Entries are limited to those sources which deal with the actual analysis phase of gamma spectroscopy but some details are present concerning equipment and sample preparation because many groups have published systems in their entirety. In every case, however, there is a section on data analysis after acquisition. Some references contain theoretical material necessary for the development of an operating system, or the results of studies of theoretical methods. All of the references are from the period 1956 to 1966. An author index is included. (auth)

21855 (AERE-Bib-152) LIST OF UNCLASSIFIED DOCUMENTS, LECTURES, ETC., BY THE STAFF OF THE CHEMISTRY DIVISION AND THE ANALYTICAL SCIENCES DIVISION, A.E.R.E., HARWELL 1966. Watts, G. C. (comp.) (Atomic Energy Research Establishment, Harwell (England)). Jan. 1967. 21p. Dep. mn. CFSTI $3.00 cy, $0.65 mn. HMSO 3s.

Unclassified reports, memoranda, conference papers, books, lectures and journal papers published or presented during 1966 are listed. 179 references are given. An author index is provided. (UK)

21856 (AERE-R-5247) THE DETERMINATION OF NITROGEN IN URANIUM NITRIDES BY INERT GAS FUSION. Taylor, B. L.; Perrett, B. S. (Atomic Energy Research Establishment, Harwell (England)). Jan. 1967. 11p. Dep. mn. CFSTI $3.00 cy, $0.65 mn. HMSO 1s. 9d.

In the method described the sample is heated to ~1900°C in a graphite resistance furnace and the nitrogen evolved is removed in a stream of helium. The nitrogen is separated from the helium by absorbing it on a molecular sieve cooled with liquid nitrogen. On completion of the reaction the molecular sieve is heated and the nitrogen pumped into a gas burette by a mercury diffusion pump. Uranium and aluminium nitrides have been successfully analyzed by this method. (auth)

21857 (AWRE-O-86/66) THE DETERMINATION OF TRACE ELEMENTS IN HUMAN HAIR BY NEUTRON ACTIVATION AND THE APPLICATION TO FORENSIC SCIENCE. Coleman, R. F.; Cripps, F. H.; Stimson, A.; Scott, H. D. (Atomic Weapons Research Establishment, Aldermaston (England)). Jan. 1967. 37p. Dep. mn. CFSTI $3.00 cy, $0.65 mn. HMSO 5s. 6d.

Using neutron activation analysis, the concentration of 12 elements in approximately 750 samples of head hair taken from a representative sample of the population of England and Wales has been determined. About 20 of these samples have been selected for a more detailed study to determine the variation of trace element content in single hairs on the same head. A limited study has also been made of the variation of hair with time and also the variation along the length of a hair. Using a statistical method of combining the data obtained from analysis it is possible to test the similarity of samples of hair and also determine the number of other heads in the population with hair similar to these test samples. This method is illustrated by the examination of ten simulated forensic cases. (auth)

21858 (BNWL-411) PLUTONIUM ABSTRACTS. Volume 7, Number 2. Russell, Barbara G. (ed.) (Battelle-Northwest, Richland, Wash. Pacific Northwest Lab.). Feb. 28, 1967. Contract AT(45-1)-1830. 43p. Dep. mn. CFSTI $3.00 cy, $0.65 mn.

References (87) are given to reports and journals published from May 1955 through February 1967. The subjects covered include biology and medicine, chemistry, health and safety, metallurgy and ceramics physics, and reactor technology. (P.C.H.)

21859 (EANDC-53(S)) ROUND TABLE ON HIGH PRECISION MASS SPECTROMETRY AND alpha-COUNTING, NOVEMBER 29-DECEMBER 2, 1965. (European Atomic Energy Community, Geel (Belgium). Central Nuclear Measurements Bureau). 474p. DTIE.

Twelve articles on mass spectrometry and alpha counting of foils are presented. The articles include information on: technical aspects of preparation and characterization of United States isotopic U and Pu standards; attainable precisions and corresponding conditions in the preparation of depleted U standards; precision estimate for routine B analysis by surface ionization mass spectrometry; optimal determination of mass discrimination in a mass spectrometer by isotopic blending; mass spectrometry at Aldermaston and some aspects related to sensitivity and precision of measurement; atomic weights as calculated from nuclidic masses and isotopic abundances; isotope dilution of U in the determination of nuclear constants; α counter with solid angle definite elevation and high precision; geometry factors in low and medium geometry solid angle counting; electrospraying technique for preparing radioactive sources; alpha-electron coincidence measurements for determining conversion coefficients in ^{241}Am decay; and weight determination of a liquid drop sample. (P.C.H.)

21860 (MAB-229-M) CHARACTERIZATION OF MATERIALS. (National Academy of Sciences-National Research Council, Washington, D. C. Materials Advisory Board). Mar. 1967. Contract DA-49-083-OSA-3131. 517p. CFSTI $3.00 cy, $0.65 mn.

The term characterization is used to mean essentially a description of those features of the composition and structure (including defects) of a material that are significant for a particular preparation, study of properties, or use, and suffice for reproduction of the material. A detailed study of characterization was made in terms of composition, structure, defects, polycrystals, and polymers. The state of the art has been documented in terms of ability to prepare a material, analyze it (composition, structure, and defects), and in turn to correlate these to property measurements. An assessment was also made of the situation surrounding some of the greatest needs for characterization such as: better techniques and instruments, or more and better use of existing techniques and instruments; better characterization for improved preparation of materials, or for improved study or use of materials; and more accurate and detailed characterization of materials in general, or just certain features of certain materials. (P.C.H.)

21861 (MG/D-332/65) PROGRESS IN MASS SPECTROMETRY FOR THE ANALYSIS OF STEEL AND HIGH-PURITY IRON. Scholes, P. H.; Bramhall, P. S. (British Iron and Steel Research Association, Sheffield (England)). Nov. 1965. 14p. Dep. mn. CFSTI $3.00 cy, $0.65 mn.

Supersedes MG/D-312/65.

A study of the application of mass spectrometry to the comprehensive analysis of steel and high purity iron is described. Some of the problems encountered, together with advantages of the technique, are discussed. (auth)

21862 (NLCO–996) SUMMARY TECHNICAL REPORT FOR THE PERIOD JANUARY 1, 1967–MARCH 31, 1967. Burgett, R. (ed.) (National Lead Co. of Ohio, Cincinnati). Apr. 1967. Contract AT(30-1)-1156. 31p. Dep. mn. CFSTI $3.00 cy, $0.65 mn.

A method was developed for analyzing neptunium (0.001 to 1,000 μg/ml) and plutonium (0.0001 to 10 μg/ml) in solutions containing as much as 500 g/l uranium. The method combines the use of a 2-thenoyltrifluoroacetone (TTA)-xylene extraction, electrodeposition from an ammonium oxalate media, and isotopic determination by alpha spectral analysis. Several methods of preparing counting samples were evaluated, i.e., evaporation, simultaneous evaporation, electroplating, and simultaneous electroplating. The precision for each phase of the analysis was determined, and the precision for the total analysis, was found to be ±9.0% relative at the 95% confidence level for the stated concentrations. A study was made of the source, nature, and development of surface defects in rolled uranium rods. The study revealed areas where further work should lead to the reduction of OD machining stock in producing uranium fuel cores. Cast binary uranium alloys containing as much as 1000 ppM of carbon, iron, silicon, or aluminum were tested with a drop hammer at temperatures ranging from 885 to 1200°F. (auth)

21863 (NP–16599) ISOTOPIC ANALYSIS OF SUBMICROGRAM AMOUNTS OF URANIUM. Bokelund, H. (European Company for the Chemical Processing of Irradiated Fuels, Mol (Belgium)). Nov. 1966. 29p. (ETR–199). Dep. mn. CFSTI $3.00 cy, $0.65 mn.

The instrumental features of the mass spectrometer installed in the Analytical Laboratory are briefly described along with the performance tests carried out prior to routine operation. The techniques used for the isotopic analysis of microgram and submicrogram amounts of uranium are given; the preliminary results on natural uranium and on 10% enriched uranium are presented. The experimental data have been used to evaluate the precision of the isotopic ratio determinations. The overall precision of the 238/235 ratio in natural uranium was found to be 0.8 and 0.5% on samples of 10^{-6} and 10^{-4}g U, respectively (relative standard deviation for a single analysis). The overall precision of this ratio in 10% enriched uranium is about 0.2% Application of a mass discrimination factor calculated from data for natural uranium yielded a bias in the 235/238 ratio of a 10% enriched sample (NBS U 100) of only 0.04% compared to the NBS certified value. (auth)

21864 (RFP–895) ANALYSIS OF AMERICIUM BY CALORIMETRY. Davis, Diana L.; Oetting, Franklin L. (Dow Chemical Co., Golden, Colo. Rocky Flats Div.). Apr. 13, 1967. Contract AT(29-1)-1106. 8p. Dep. mn. CFSTI $3.00 cy, $0.65 mn.

A method for the analysis of americium was developed and is described. The method is based on calorimetric measurement of the power emitted by the radioactive decay of ^{241}Am and correlating this measured power to the amount of americium in the sample. Experimental results show that the calorimetric method is more consistent and more accurate than the emission spectrographic method. (auth).

21865 (TIM–906) VALIDITY OF DETERMINING CARBON IN LITHIUM BY MEASUREMENT OF ACETYLENE EVOLVED ON HYDROLYSIS. Hobart, E. W.; Bjork, R. G. (Pratt and Whitney Aircraft, Middletown, Conn. Connecticut Advanced Nuclear Engineering Lab.). [1965]. Contract AT(30-1)-2789. 14p. Dep. mn. CFSTI $3.00 cy, $0.65 mn.

Carbon, both elemental and combined, was recovered as acetylene after fusion with lithium at 600°C and hydrolysis of the resulting mixture. Chromatographic analysis of the gases evolved on hydrolysis revealed only traces of ethane or ethylene, presumably resulting from hydrogenation of acetylene. Lithium carbonate was reduced rapidly by lithium at temperatures above 500°C. Recoveries of acetylene evolved on hydrolysis of lithium samples previously maintained at high temperatures demonstrate the validity of the method for determining carbon in lithium. (auth)

21866 (UCID–15074) SEMIMICRO DETERMINATION OF FLUORINE IN PLASTIC-BONDED EXPLOSIVES. Selig, Walter (California Univ., Livermore. Lawrence Radiation Lab.). Feb. 17, 1967. Contract W-7405-eng-48. 7p. Dep. mn. CFSTI $3.00 cy, $0.65 mn.

A method for the determination of 1 to 20 mg of fluorine in organic materials, with emphasis on high explosives, is presented. Up to 1 g of the sample is burned by the oxygen-bomb technique. After the carbon dioxide is removed from the combustion products, the fluoride is titrated with a standard potassium aluminum sulfate solution in 50% ethanol. The titration is monitored with a pH meter and can easily be automated. (auth)

21867 (UCRL–17144(Rev.)) ANALYSIS FOR YTTRIUM WITH A SEMICONDUCTOR X-RAY EMISSION SPECTROGRAPH AND AN ^{125}I SOURCE. Klecka, Jack F. (California Univ., Berkeley. Lawrence Radiation Lab.). Oct. 3, 1966. Contract W-7405-eng-48. 18p. Dep. mn. CFSTI $3.00 cy, $0.65 mn.

Yttrium solutions mounted either on Mylar film strips or ion exchanged loaded paper were placed in a sample holder and the x rays excited in Y by an ^{125}I source were measured by a semiconductor for a period of time ranging from 10 to 30 min depending upon the sample size. In the case of 1 μg samples considerably larger count periods were used. The results of the two different types of sample preparation (Mylar film and ion exchanged loaded paper) were compared. Calibration curves and background were very similar. The results obtained were found to be similar to those obtained previously by others. (P.C.H.)

21868 (UCRL–17166(Rev.)) QUANTIATIVE ANALYSIS OF URANIUM AND THORIUM SOLUTIONS WITH A SEMICONDUCTOR X-RAY EMISSION SPECTROMETER. Klecka, Jack F. (California Univ., Berkeley. Lawrence Radiation Lab.). Oct. 3, 1966. Contract W-7405-eng-48. 15p. Dep. mn. CFSTI $3.00 cy, $0.65 mn.

A spectrometric method is described for determining Th and U in solutions using ^{125}I sources and a lithium-drifted silicon semiconductor. The curve for the observed count rates with L_α peaks for the various concentrations was linear within the counting statistics below a concentration of about 2.6 mg/ml. Below a concentration of 0.1 mg/ml the ratio of L x-ray count to background became too small to give dependable results without a great increase in counting time. Methods for obtaining greater sensitivity are suggested. Preliminary trials with a ^{57}Co source of roughly the same strength as the ^{125}I source indicated about a tenfold decrease in counting rate. (P.C.H.)

21869 SUBSTOICHIOMETRIC DETERMINATION OF MANGANESE IN THE REAGENTS AND IN THE TARGET MATERIAL IN ^{52}Mn PRODUCTION BY ACTIVATION ANALYSIS. Mudrova, B.; Kukula, F. (Inst. for Nuclear Research, Czechoslovak Academy of Sciences, Rez). Isotopenpraxis, 3: 51-3(Feb. 1967). (In German).

The determination of trace amounts of manganese by activation analysis followed by chemical separation is described. The separation principle includes substoichiometric extraction of the bivalent manganese by thenolytrifluoracetone (TTA) in ethylacetate. The method is simple, rapid, and enables the selective separation of manganese. It was applied for the determination of manganese in both the target material and the reagents used for ^{52}Mn production. (auth)

21870 DETERMINATION OF TRACES OF METALS IN NUCLEAR MATERIALS. Kuvik, Viliam (Inst. for Nuclear Research, Czechoslovak Academy of Sciences, Rez). Chem. Litsy, 61: 149-70(Feb. 1967). (In Czech).

The current state of the art is reviewed (151 references) for determination of low concentrations of impurities in nuclear materials, and lines along which future developments should be made are indicated. Nuclear data (e.g. cross sections, half-lives, isotope abundances) useful in neutron activation analysis are tabulated for thirty-one elements that may have to be determined, in low concentrations, in association with natural or enriched ^{235}U uranium, and interferences are discussed. Some details of methods for these elements and others are reviewed, and various methods in common use (e.g. polarographic, colorimetric, coulometric, spectrometric) are compared. Spectrophotometric methods are stated to have an accuracy of ±7%. Activation analysis and spectrographic methods are less accurate, i.e., ±15% and ±30%, respectively, but often these accuracies are sufficient. (TTT)

21871 MEASUREMENT OF D_2O IN PLASMA WATER BY FREEZING POINT ELEVATION, FALLING DROP, INFRA-RED ABSORPTION, AND GAS CHROMATOGRAPHY. Graystone, Joan; Seitchik, Joy; Milch, R.; Shulman, G. P.; Cheek, D. B. (Johns Hopkins Hospital, Baltimore. Sinai Hospital, Baltimore. Martin Co., Baltimore). J. Lab. Clin. Med., 69: 885-92(May 1967).

Four methods (falling drop, freezing point elevation, infrared absorption, and gas chromatography) were used to determine deuterium oxide concentration in plasma water. An appraisal of the accuracy of each method in estimation of the concentration of samples with known deuterium oxide content is presented. The results indicate that the falling drop method, although the only technique with adequate recovery over the range of concentrations studied, shows a systematic variation from the theoretical concentration of the sample. The methods involving freezing point elevation and infrared absorption exhibit less variability but significantly underestimate deuterium oxide content. The application of the gas chromatographic method to concentrations below 0.4

vol % presents practical difficulties and the greatest variability in measurement. Statistical analysis of the data relating to body water volumes (calculated from the plasma water D_2O concentrations) in a group of children indicates a significant difference between the results obtained by each method. (auth)

21872 LIQUID–LIQUID EXTRACTION OF TECHNETIUM AS TETRAPROPYLAMMONIUM SALT AND SPECTROPHOTOMETRIC DETERMINATION AS THE THIOCYANATE COMPLEX. Foster, Robert E. Jr.; Maeck, William J.; Rein, James E. (Idaho Nuclear Corp., Idaho Falls). Anal. Chem., 39: 563-6(May 1967).

A method is described for the liquid–liquid extraction, spectrophotometric determination of technetium in nuclear tests. The tetrapropylammonium-pertechnetate salt is doubly extracted from a basic medium into chloroform and the colored technetium(V)-thiocyanate complex is formed in the chloroform phase by the addition of sulfuric acid, potassium thiocyanate, and tetrapropylammonium hydroxide. The colored complex absorbed at 513 mμ, had a molar absorptivity of 46,000, and was stable for several hours. Of over 50 metals studied, none interfered at less than a 100 to 1 mole ratio to technetium. Most anions are without interference. The standard deviation for a single determination was 0.09 μg over the range 1 to 20 μg of technetium. (auth)

21873 IMPROVED SOLVENT EXTRACTION SEPARATION OF MOLYBDENUM FROM NUCLEAR FUELS FOR ISOTOPE DILUTION MASS SPECTROMETRIC ANALYSIS. Marsh, S. Fredric (Idaho Nuclear Corp., Idaho Falls). Anal. Chem., 39: 696(May 1967).

A procedure for the separation of molybdenum from nuclear fuels by solvent extraction from hydrochloric acid–sulfuric acid solution using amyl acetate is proposed. No attempt was made to eliminate tellurium as it neither interferes in the mass analysis of molybdenum nor poses a radiological hazard in aged fuel. After separation the molybdenum was determined by isotope mass spectrometric analysis. The procedure was used to measure the molybdenum fission yields from ^{233}U, ^{235}U, and ^{239}Pu nuclear fuels. (D.H.M.)

21874 SPECTROPHOTOMETRIC DETERMINATION OF TANTALUM IN BORON, URANIUM, ZIRCONIUM, AND URANIUM–ZIRCALOY-2 ALLOY WITH MALACHITE GREEN. Eberle, A. R.; Lerner, M. W. (Atomic Energy Commission, New Brunswick, N. J.). Anal. Chem., 39: 662-4(May 1967).

An efficient separation of traces of tantalum from relatively large amounts of boron, involving the coprecipitation of tantalum with iron(III) precipitated with ammonium hydroxide, was found. This procedure was also effective in separating tantalum from uranium, zirconium, and uranium–Zircaloy-2 in the presence of suitable complexing agents. Additional studies of the extraction of the malachite green-tantalum–fluoride complex by benzene resulted in certain differences between our conclusions and those drawn previously. (D.H.M.)

21875 SIMPLE AND ACCURATE CALIBRATION MODEL FOR HYDROGEN-CONTENT, BETA-PARTICLE BACKSCATTER GAGES. Gardner, Robin P. (Research Triangle Inst., Research Triangle Park, N. C.). Anal. Chem., 39: 668-71(May 1967).

A model that explains the apparent anomaly between experimental observations and the theory of beta-particle scattering is presented. The derived model is found to be simple and accurate enough for use as a calibration relation for beta-particle backscatter gauges. The use of "effective atomic numbers" or "effective stopping powers" was avoided. The model was checked against experimental data from the literature. (D.H.M.)

21876 SEPARATION OF LANTHANIDE FISSION PRODUCTS FROM NUCLEAR FUELS BY EXTRACTION CHROMATOGRAPHY AND CATION EXCHANGE FOR ISOTOPE DILUTION MASS SPECTROMETRIC ANALYSIS. Marsh, S. Fredric (Idaho Nuclear Corp., Idaho Falls). Anal. Chem., 39: 641-5(May 1967).

A rapid (4-hour), specific, three-column sequential separation procedure was developed for the carrier-free isolation of the individual lanthanides from spent nuclear fuels for their measurement by isotope dilution mass spectrometry. The first column separated the lanthanide group from the trivalent actinides and all other fission products by extraction chromatography. The extractant was di-(2-ethylhexyl) phosphate (D2EHP) in diisopropylbenzene supported on chromatographic-grade Chromosorb; the elutriant was lactic acid–sodium diethylenetriaminepentaacetate. The second column used undiluted D2EHP on Chromosorb to selectively retain tetravalent cerium from strong nitric acid–potassium bromate, while the trivalent lanthanides eluted. On the final column (cation exchange) the individual lanthanides were separated by chromatographic elution with ammonium α-hyroxyisobutyrate at controlled pH. All three columns operated at room temperature. After the first two columns, which required only 1 hour, the separated trivalent lanthanide fraction was sufficiently free of radioactivity for transfer from remotely operated facilities to a conventional laboratory. Mechanical innovations in the procedure allowed a semiautomated system for more convenient operation. (auth)

21877 DETERMINATION OF DEUTERIUM IN GASES BY NEUTRON TIME-OF-FLIGHT SPECTROMETRY. Peisach, Max; Pretorius, Rene (Southern Universities Nuclear Inst., Faure, South Africa). Anal. Chem., 39: 650-7(May 1967).

A method for the determination of deuterium in gases using time-of-flight spectrometry of neutrons emitted in (d,n) reactions is given. A pulsed deuteron beam of 2.0, 2.4, or 3.0 MeV was used. Deuterium was determined in hydrogen, nitrogen, oxygen, and carbon dioxide at partial pressures ranging from 1 to over 100 mm. The average time taken for an analysis was about 10 minutes. The relative standard deviation was ±3.4% and the sensitivity, 2.5×10^{-4} grams per sq cm beam area, was sufficient to detect deuterium in natural hydrogen. (auth)

21878 DETERMINATION OF ARSENIC BY THE URANYL SALT METHOD. PART II. THE RADIOMETRIC DETERMINATION OF MICROGRAM AMOUNTS OF ARSENIC BY A FILTER-SPOT TECHNIQUE. Wilson, A. D.; Lewis, D. T. (Lab. of the Government Chemist, London). Analyst, 92: 260-3(Apr. 1967).

Development of the uranyl salt method for the gravimetric determination of arsenic is described. Gravimetric manipulations are conducted on a filter paper base and the arsenic content of the ammonium uranyl arsenate precipitate is determined indirectly by measuring the alpha count-rate of the associated uranium. The method was demonstrated applicable in the range 1 to 8 μg of arsenic. (auth)

21879 DETERMINATION OF PLUTONIUM IN REFRACTORY MATERIALS BY ELECTROMETRIC METHODS AFTER DISSOLUTION BY FUSION WITH AMMONIUM HYDROGEN SULFATE. Milner, G. W. C.; Wood, A. J.; Weldrick, G.; Phillips, G. (Atomic Energy Research Establishment, Harwell, Eng.). Analyst, 92: 239-46(Apr. 1967).

A fusion with ammonium hydrogen sulphate at 400°C was developed for the dissolution of refractory materials containing plutonium dioxide. On cooling, the melt is leached with sulphuric acid to produce a solution suitable for plutonium analysis by electrometric methods. Plutonium concentrations (about 2 mg/ml) are determined either by a potentiometric titration based on the reduction of plutonium(VI) to plutonium(IV), or by a controlled-potential coulometric method, the Pu^{3+}–Pu^{4+} couple being used. Both techniques are suitable for the accurate determination of plutonium, with a precision of better than 0.20% (coefficient of variation) for about 5 mg amounts or less. The behaviour of many other elements with these methods was studied in some detail. The fusion technique was found suitable for the dissolution of several refractory materials, including samples of PuO_2–UO_2 fired at 1550°C, and also samples of PuO_2–ThO_2 produced by the ignition at 900°C of the carbides of these elements coated with pyrolytic graphite. The determination of the plutonium contents of these samples was completed directly by electrometric methods. (auth)

21880 POTENTIOMETRIC DETERMINATION OF RARE EARTHS WITH SODIUM TUNGSTATE. Shivahare, G. C.; Verma, R. C. (Univ. of Jodhpur, India). Z. Anal. Chem., 227: 279-80(1967).

A method was developed for the rapid determination of an individual rare earth while studying single elements. Sodium tungstate reacted with rare earths giving a precipitate of sparingly soluble rare-earth tungstate. This reaction was followed quantitatively with potentiometric end-point detection using a glass electrode. A sharp change in the emf was observed at the equivalence point corresponding to complete precipitation of $R_2(WO_4)_3$ at pH above 6.8. While results are given only for Sm; La, Nd, and Pr were also determined by this method. The glass electrode simplifies estimations and accuracy is quite good even at low concentrations. (P.C.S.)

21881 MEASUREMENT OF BONE MINERAL AND BODY COMPOSITION IN VIVO. Cameron, John R.; Sorenson, James A. (Univ. of Wisconsin, Madison). pp 37-42 of IVth Nordic Meeting on Clinical Physics, Proceedings. Rytila, A.; Spring, E. (eds.). Helsinki, University Central Hospital, 1966.

An accurate technique for measuring bone mineral content in vivo is described that uses the transmission of a monoenergetic photon beam through the sample measured with a scintillation detector. The amount of mineral in the photon beam path is related to the transmission rates and a simple equation is used to calculate mineral content. The photon source is about 100 mCi of ^{125}I with a tin filter that leaves a beam consisting of 95% of 27.4 keV photons. The radiation dose to the patient is less than

2 mR per scan. The technique is useful for following changes in bone mineral over a long period of time. A technique for the determination of the ratio of fat to muscle in soft tissues is also described that uses the transmission of two monoenergetic photon beams of different energies (^{241}Am with 60 keV photons and ^{125}I with 27.4 keV photons). Results on humans were not as good as results on samples of homogeneously mixed fat and muscle tissue. (C.H.)

21882 DETERMINATION OF STRONTIUM IN HUMAN SERUM USING NEUTRON ACTIVATION ANALYSIS. Teree, Thomas M. (Western Reserve Univ., Cleveland); Cohn, Stanton H. Contract AT(30-2)-Gen-16. J. Nucl. Med., 7: 848-58(Nov. 1966). (BNL-9552).

A new method for determination of strontium in human serum using neutron activation analysis was developed. Methods previously used include flame emission spectroscopy and x ray fluorescent spectroscopy. The disadvantage of these methods is that large samples are required for analysis of strontium. Difficulties of previous methods are obviated by the new method. Tables are presented showing results of determinations of ^{87}Sr and stable strontium. (H.L.W.)

21883 RADIOMETRIC DETERMINATION OF SUBMICROGRAM AMOUNTS OF MERCURY. Stary, Jiri (Univ., Prague); Milosevic, Radule. Talanta, 14: 521-2(Apr. 1967).

A radiometric method for the determination of submicrogram amounts of mercury (down to 5×10^{-10} g/ml) is described. The method is based on the exchange reaction between mercury and silver-110^{m} dithizonate. Only palladium, gold, silver, and large amounts of copper and bismuth interfere in the determination, and must be removed. (auth)

21884 EXTRACTIVE PHOTOMETRIC DETERMINATION OF THORIUM WITH ARSENAZO DAL. Budesinsky, Bretislav; Menclova, Blanka (Inst. of Nuclear Research, Czechoslovak Academy of Sciences, Rez). Talanta, 14: 523-5(Apr. 1967).

Arsenazo DAL (the dianilide of 3,6-bis(2'-arsonophenylazo)-4,5-dihydroxy-2,7-naphthalenedisulphonic acid) is proposed as an extractive photometric reagent for the highly selective determination of trace amounts of thorium. (auth)

21885 SIMULTANEOUS ESTIMATION OF COPPER, ZINC, CADMIUM, AND MERCURY IN BIOLOGICAL MATERIAL BY NEUTRON ACTIVATION ANALYSIS. Livingston, H. D.; Smith, Hamilton; Stojanovic, Nikola (Glasgow Univ.). Talanta, 14: 505-13(Apr. 1967).

The simultaneous determination of copper, zinc, cadmium, and mercury with high sensitivity is possible by neutron activation analysis. After irradiation, the samples are digested and an initial separation of the four elements made by means of an ion-exchange resin. The elements in the separated fractions are then treated to give radiochemical purity, precipitated, and their activities measured. A purely instrumental technique for the analysis of zinc in samples of biological material is also described. The samples are irradiated for a week and after the activity has decayed for about three months it is measured on a gamma spectrometer. (auth)

21886 SPECTROPHOTOMETRIC DETERMINATION OF SCANDIUM WITH BROMOPYROGALLOL RED. Shimizu, Tsuneo (Gunma Univ., Maebashi, Japan). Talanta, 14: 473-9(Apr. 1967).

A highly sensitive spectrophotometric determination method for scandium using Bromopyrogallol Red is described; microgram amounts of scandium can be determined by measurement at 610 mμ and pH 6.1. The molar absorptivity is 2.4×10^4 at 610 mμ. Formation of a 1:1 complex of scandium with Bromopyrogallol Red is confirmed. Common cations interfere, but can be separated completely by three successive ion-exchange steps; the method can be applied to the determination of traces of scandium in silicate rocks. Results are quoted for scandium in several types of igneous rocks. (auth)

21887 RADIOCHEMICAL DETERMINATION OF LOW CONCENTRATIONS OF RADIUM IN WATER. Vermirovsky, Jaroslav; Bucina, Ivan (Inst. of Radioisotopic Study and Production, Prague). Jad. Energ., 12: 413-21(Nov. 1966). (In Czech).

Various methods for determination of low concentrations of radium in water are surveyed. A radiochemical method is suggested in which the radium is precipitated with Pb(Ba)SO_4; following its dissolution in EDTA it is again precipitated with $BaSO_4$; the precipitate is mixed with the phosphor ZnS(Ag) and the ^{226}Ra activity measured. Optimum precipitation conditions were found and α counting improved. Various α counting methods are compared. The order of error for 0.12 pg/l in 2 l of water is ±25%. (tr-auth)

21888 AUTOMATIC DISCRIMINATING PRINTOUT SYSTEM FOR QUANTOMETRIC ANALYSES. Theiring, John W.; Kramer, Joe; Pepper, Charles E. (National Lead Co. of Ohio, Cincinnati). Contract AT(30-1)-1156. Appl. Spectros., 21: 114-21 (Mar.-Apr. 1967). (NLCO-942; CONF-650809-1).

A custom-designed printout system was installed on a 1.5 m Industrial Research Quantometer to print automatically three-digit values in parts per million of up to 24 elements which were determined in a matrix of uranous-uranic oxide (U_3O_8). The individual element values from the duplicate sample analyses are printed on adjacent lines at the rate of 24 values per 20 sec. The use of this electronic discriminating printout system reduces the number of data that must be handled manually. It also minimizes the possibility of errors occurring in reading and recording the data and in the calculating and discriminating procedures normally performed by technicians. (auth)

21889 TOTAL-BURN SPECTROGRAPHIC DETERMINATION OF SILICON IN PLUTONIUM. Ko, Roy (Battelle-Northwest, Richland, Wash.). Appl. Spectros., 21: 86-8(Mar.-Apr. 1967). (BNWL-SA-194).

A total-burn spectrographic method was applied to the determination of trace concentrations of silicon in plutonium. The sample was oxidized to plutonium dioxide, mixed with a germanium dioxide-graphite mixture containing tin internal standard, packed into cupped graphite electrodes, and burned to completion in a high-amperage dc arc. Plutonium spectral interference was avoided by using the less sensitive Si 2506.90 Å line. The lower limit of the determination was 25 ppM of silicon in plutonium. The precision of the method was estimated to be ±8% (coefficient of variation) at the 270 ppM level and ±14% at 40 ppM. (auth)

21890 SPECTROPHOTOMETRIC DETERMINATION OF SCANDIUM WITH NAPHTHYL AZOXINE S. Shimizu, Tsuneo (Gunma Univ., Japan). Bunseki Kagaku, 16: 233-8(Mar. 1967). (In Japanese).

Scandium reacts with NAS [7-(6-sulfo-2-naphthylazo)-8-hydroxyquinoline-5-sulfonic acid] to give a complex at pH 4.1 to 6.3. The colored solution has an absorption maximum at 420 mμ. Beer's law is obeyed over the range from 0.4 to 3.6 ppM of scandium. Molar extinction coefficient at 420 mμ is 8×10^3. The absorbance is not highly sensitive to reagent concentration and pH. The complex remains stable for an hour. Many cations interfere, but can effectively be separated from scandium by ion exchange methods enough to permit the spectrophotometric determination of scandium with NAS. The ion exchange methods consist of cation and anion exchange in acid sulfate media and anion exchange in hydrochloric acid solution. The presence of 1:1 complex is confirmed by spectrophotometric conductimetric and potentiometric studies. (auth)

21891 THE STUDY OF HYDROELECTROLITIC METABOLISM IN MAN BY MUSCULAR BIOPSIES ANALYSIS (WITH SPECIAL REFERENCE TO NEUTRON ACTIVATION). Dubois, J. (Univ. Libre, Brussels); Colard, J.; Vis, H. L. J. Nucl. Biol. Med., 10: 39-51(Apr.-June 1966).

The different methods of analysis of muscle tissue obtained by biopsy for the study of hydroelectrolytic metabolism are reviewed. The neutron activation technique is shown to be of practical use and to yield results in good agreement with the chemical methods. Available techniques have been adapted to pediatric use, and they are shown to represent a valuable tool for investigating intracellular hydroelectrolytic pattern in disease states. The changes in the muscle content of water and electrolytes with age are discussed. (33 references.) (C.H.)

21892 VOLUMETRIC ANALYSIS AND CATALYSIS. II. CHELATOMETRIC TITRATION. Weisz, H.; Janjic, T. (Univ., Freiburg i. B.). Z. Anal. Chem., 227: 1-7(1967). (In German).

A study on the application of catalytic reactions to end-point indication in volumetric analysis was continued. Catalytic reactions which can be used in chelatometric determinations were investigated. These are oxidation reactions of alizarin S, α-naphthol, hydroquinone, resorcinol, catechol, metol or dimethyl-p-phenylenediamine with hydrogen peroxide and of tiron with sodium perborate. Numerous new chelatometric determinations are described either by direct titration (Co, Cu, Mn, Fe, and Ni) or by back titration (Hg, Pb, Bi, Cd, Al, In, Ni, Zn, Th, Ga, Y, La, and Ce). (auth)

21893 ACTIVATION ANALYSIS DETERMINATION OF TRACE ELEMENTS IN STONE METEORITES. I. SELENIUM, ARSENIC, ANTIMONY, TIN, MERCURY (CHROMIUM AND COBALT). Kiesl, W. (Univ., Vienna). Z. Anal. Chem., 227: 13-22(1967). (In German).

Trace quantities of selenium, arsenic, antimony, tin, and mercury were isolated from meteorites and minerals after preliminary activation of the samples in a reactor core followed by distillation of the halides from the matrix materials. In the distillate selenium was first precipitated in the presence of strong hydrochloric acid using sulfur dioxide as reducing agent. Further sepa-

ration was effected on the anion exchanger Dowex 1-X8. On this resin antimony, tin, and mercury were retained while in the effluent arsenic was precipitated as trisulfide and then subjected to measurement. For separation of the adsorbed elements antimony, tin, and mercury two different techniques are discussed. In one case antimony was eluted with aqueous 10% ascorbic acid solution 0.4 N in hydrochloric acid and in the other, which appears to be more advantageous, an aqueous 10% solution of ammonium fluoride 0.5 N in hydrochloric acid was employed. Subsequently in both cases tin and mercury were removed from the resin using 22 N orthophosphoric acid and nitric acid (normality not below 7 N), respectively. The recoveries of this separation method were also determined radiochemically. (auth)

21894 NUCLEAR MAGNETIC RESONANCE OF MICROSAMPLES. Frost, D. J. (Unilever Research Lab., Sharnbrook, Eng.); Hall, G. E.; Green, M. J.; Leane, J. B. Chem. Ind. (London), No. 2, 116-17(Jan. 14, 1967).

Techniques and apparatus used to obtain NMR spectra of microgram amounts of substances are described. A spherical microcell was used in combination with a Perkin-Elmer R.10, 14,094-G NMR spectrometer. The spherical microcells used were disposable. The cells were blown at the end of a Griffin and George glass melting point tube (1.65 mm. OD), rotated in a flame by an electric motor. The cell was mounted in a silicone rubber sleeve bonded to the inside of a 13-cm length of 5-mm OD glass tubing by Silastic RTV731. This tubing was suspended inside the probe from an AEI R82 air-bearing mounted in the spinner cup so that the sphere was inside the r-f coil. The spinner cup contained a 5-mm bearing which is required to give sufficient lateral stability during spinning. Experiments were conducted on a series of spheres of various dia containing acetaldehyde. On increasing dia over the range 3.0 to 4.5 mm the signal area per unit volume doubled. Over the same range of dia the signal height per unit volume (an effective measure of sensitivity) tripled, reflecting improved resolution. A cell dia of 4.5 mm was adopted. Results obtained showed that using the microcells and the computer as described, a splitting of 2.4 cps is readily observed in a 600 cps field scan. Some spectra of ethyl benzene are illustrated. The use of the spherical microcell gave a weight advantage factor of about 5, while a further factor of 10 to 20 was readily obtainable using a computer. The result was that 26 μg of ethyl benzene could be observed at 60 Mcps. The facility for rapid accumulation of spectra on the computer furnished useful results from such nuclei as ^{31}P, ^{11}B, ^{14}N, and ^{13}C. (BBB)

21895 USE OF THE ANION EXCHANGER WOFATIT SBW FOR THE CONCENTRATION OF ^{131}I. Brutovsky, M.; Zaduban, M. (Inst. for Experimental Biology, Kosice, Czechoslovakia). Collect. Czech. Chem. Commun., 32: 505-16(Feb. 1967). (In German).

The characteristics of the anion exchanger Wofatit SBW for the determination of ^{131}I in water and biological materials were evaluated. For investigation of the proportionately high yield of radioactive iodide the influence of solution pH, the amount of iodide carrier, the flow-through velocity of the solution in the anion exchanger column, the concurrent ions, as well as the quality and concentration of the elution means were determined. (tr-auth)

21896 ACTIVATION ANALYSIS BY γ PHOTONS AND CHARGED PARTICLES. Albert, Philippe (CNRS, Vitry, France). Chimia (Aarau), 21: 116-25(Mar. 15, 1967). (In French).

Some results of a study of the possibilities in activation analysis using γ photons and charged particles are reported. The conditions for (γ,n) activation of oxygen, nitrogen, and carbon in trace analysis are given and the possibilities of γ activation analysis for some other elements are discussed. Attention is drawn to the interest of developing charged-particle activation analysis not only for gases (O, N, C) but also for boron, titanium, iron, and a large number of other elements. A study on oxygen activation analysis in aluminum is reported as an example that may show how the best conditions for a charged particles activation analysis in one particular material can be found. (auth)

21897 RADIOCHEMICAL METHODS IN ANALYTICAL CHEMISTRY. II. NEUTRON ACTIVATION ANALYSIS. Bowen, H. J. M. (Univ. of Reading, Eng.). Chimia (Aarau), 21: 113-16(Mar. 15, 1967).

Activation analysis is a technique of elementary analysis in which samples are exposed to a high flux of neutrons, and the radioactivity induced in selected elements is compared with that produced in known standards. It has the following advantages: wide applicability, sensitivities ranging from 10^{-6} to 10^{-14} g, absence of reagent contamination, built-in checks on reliability, possibility of determining individual isotopes, and reasonable cost. Its disadvantages include: it is only a method of elementary analysis; it needs a source of neutrons; and it is inapplicable to most of the lighter elements which activate to nuclides of short half-life. Current trends in activation analysis include automation of techniques and the development of laboratory neutron sources. Applications are doubling every 3.3 years, notably in the fields of semi-conductor research, metallurgy, geochemistry, cosmochemistry, and inorganic biochemistry. (auth)

21898 ACTIVATION ANALYSIS OF SOLUBLE AND FIXED SODIUM IN MAMMALIAN HAIR. Kennington, Garth S. (Univ. of Wyoming, Laramie). Science, 155: 588-9(Feb. 3, 1967).

Antelope hair was soaked in sodium-22 to stimulate external contamination and then systematically washed to remove all traces of the sodium; progress of the wash was followed by gamma-ray spectrometry. Hair was then activated by neutron bombardment. Subsequent analysis revealed that sodium was still present as sodium-24. It was concluded that a fraction of the sodium in hair could be readily washed away with water and that a second fraction was held in the hair in such a manner that extended washing did not remove it. This suggested that sodium in two states may be associated with hair, one as an external contaminant and the other as a more nearly integral part of the hair. (auth)

21899 SPECTROGRAPHIC DETERMINATION OF IMPURITIES IN URANIUM TETRAFLUORIDE. Capdevila Perez, C.; Roca Adell, M.; Alvarez Gonzalez, F. (Junta de Energia Nuclear, Madrid). An. Real Soc. Espan. Fis. Quim. (Madrid), Ser. B, 63: 289-95(Mar. 1967). (In Spanish).

A carrier distillation method for the determination of Ag, Al, As, B, Cd, Cr, Cu, Fe, Mg, Mn, Ni, Pb and Si in uranium tetrafluoride was developed. Previous addition of 25% Y_2O_3 prevented the excitation of uranium by conversion of the volatile UF_4 into U_3O_8 during the arc discharge. NaCl or Ga_2O_3, containing Ge and V as internal standards, are used as carriers, and samples are arced in 10 dc arc in a graphite anode cup, 7 mm diameter, 10 mm deep, the weight of the charge being 300 mg. Sensitivities were in the range 0.1 to 20 ppM and the precision attained lay between ±9.0 and ±16.4%. For Ca and P, samples are mixed with SiO_2 and converted into the black oxide by heating at 400°C. (auth)

21900 AN APPROXIMATE ANALYSIS OF MOISTURE DETECTION BY NEUTRONS THROUGH USING A MODERATOR. Hattori, Taikichi. Radioisotopes (Tokyo), 16: 61-7(Feb. 1967). (In Japanese).

An investigation was made of the effects of energy-dependent neutrons on moisture detection in thin slabs using geometrical arrangement. The surface of the moderator was covered with the cadmium plate, and results showed that the epicadmium neutrons contribute little to moisture detection. The neutrons used were thermal neutrons (0.025 to 0.07 eV) and slow neutrons (0.07 to 0.5 eV). Two-group diffusion equations were used to calculate the rate of the thermalization of slow neutrons in the slab, and on the assumption that thermal neutrons reciprocated repeatedly through the air gap where detectors were placed between the moderator and the slab, the total number of neutrons corresponding to the counting rate was calculated with the aid of the rate of thermalization obtained, the albedo of thermal neutrons, and the decrement rate of neutron current density in the air gap. The results were in good agreement with the experimental results at various moisture contents, and it was quantitatively shown that the thermalization of slow neutrons and thermal neutrons repeatedly reflected in both the moderator and the slab contributes remarkably to moisture detection. (D.H.M.)

21901 METHODS OF X-RAY FLUORESCENCE ANALYSIS BY MEANS OF RADIOISOTOPES. Martinelli, P. (CEN, Saclay, France). Chimia (Aarau), 21: 151-9(Apr. 13, 1967). (In French).

X-ray fluorescence analysis is carried out by exciting the inner energetic levels of the atoms (K,L levels) and measuring the intensities of the characteristic x-ray lines emitted by the elements to be analyzed. Excitation is generally obtained by means of x rays or accelerated electrons from generator tubes. These techniques are being developed intensely. But it is also possible to use radioactive sources emitting α, β^- or photons. Interesting features of the use of radioactive sources are: stability of the exciting spectrum, small size, cheapness, availability of a large variety of spectrum shapes and sources. They are used in portable apparatuses and are particularly attractive for continuous control. However, because of their low intensity, it is not possible to analyze accurately the radiations emitted by the irradiated samples. It is necessary to use methods other than diffraction to determine the intensities of the K and L x-ray lines. So they are mainly used to determine the content of known elements in matrixes of relatively stable composition. They can also be applied to the solution of more complex problems. Various techniques using radioactive sources are proposed. A number of industrial applications is already made. By their contribution to automatization, these radioactive techniques have a large interest for the near future. (auth)

21902 FERROUS METALLURGY. Pasztor, L. C.; Hines, C. R. (Jones and Laughlin Steel Corp., Pittsburgh). Anal. Chem., 39: 92R-102R(Apr. 1967).

Advances in ferrous metallurgical analysis from October, 1964 to December, 1966 are reviewed. The majority of methods still involve modifications of well established techniques and procedures rather than the introduction of new approaches. The greatest progress was made in the application of atomic absorption spectrometry and neutron activation techniques to the routine analysis of iron, iron ores, slags, and steels and in the automation and computerization of chemical and instrumental methods. Emission and x-ray spectrometric, atomic absorption spectrophotometric, and other instrumental techniques with various degrees of automation became the most important means for better process and quality control. The determination of the following elements is discussed: Al; Sb; As; Be; Bi; B; Cd; Ca; C; Cr; Co; Cu; H; N; O; Hf; Pb; Mg; Mn; Mo; Ni; Nb; Ta; P; Se; rare earths; Si; S; Sn; Ti; Th; W; U; V; Zn; and Zr. The use of emission, flame, and mass spectrometry and x-ray and electron microprobe is reviewed. (D.H.M.)

21903 NONFERROUS METALLURGY. I. LIGHT METALS. Oliver, Richard T.; Cox, Ernest P. (Aluminum Co. of America, New Kensington, Pa.). Anal. Chem., 39: 102R-110R(Apr. 1967).

Advances in nonferrous metallurgical analysis from September, 1964 to August, 1966 are reviewed. Significant progress was made in atomic absorption analysis and inorganic gas chromatography emerged from infancy. The development and refinement of ion exchange separation of metals was noteworthy. A slow, but obvious, trend toward automation of analysis in the nonferrous industry was evident. Various methods used in the determination of the following elements in nonferrous metallurgical materials are discussed: Al; Sb; B; Be; C; Ca; Cd; Cl; Co; Cu; F; Fe; Ga; H; In; K; Li; Mg; Mn; Mo; N; Na; K; Ni; O; P; Pb; Pd; rare earths; S; Si; Sn; Ti; U; V; Zn; and Zr. Methods for the determination of various constituents in Al, Al alloys; Al_2O_3, Al_2SiO_5, bauxites, Be, BeO, Mg, magnesites, Ti, TiO_2, and Ti alloys are listed. (D.H.M.)

21904 WATER ANALYSIS. Fishman, M. J.; Robinson, B. P.; Midgett, M. R. (Geological Survey, Denver, Colo.). Anal. Chem., 39: 261R-294R(Apr. 1967).

A review of the literature of analytical chemistry applied to water analysis covering the period from October, 1964 to September, 1966 is presented. Some of the methods mentioned are photometry, gas chromatography, polarography, paramagnetic oxygen measurements, spectrophotometry, ion exchange, automated procedures, neutron activation, and stable isotope dilution. The use of these methods in determining alkali metals, alkaline earth metals, Fe, Mn, Cr, Al, Cu, Zn, Pb, Cd, Ni, Co, Bi, Sb, As, Au, Hg, V, Ta, Sc, Zr, U, B, Se, F, sulfates, sulfites, sulfides, silica, P, Ag, nitrates, nitrites, O, and other gases, detergents, pesticides, herbicides, and organics in water is discussed. Radioactivity and isotopic analysis are also covered. (D.H.M.)

21905 RADIOCHEMICAL METHODS IN ANALYTICAL CHEMISTRY. III. CHEMICAL AND RADIOCHEMICAL APPLICATIONS OF THE MOESSBAUER EFFECT. Zahn, U. (Technische Hochschule, Munich). Chimia (Aarau), 21: 145-68(Apr. 13, 1967). (In German).

The electron density and the electric field gradient at the nucleus in a crystal can be deduced from the isomer shift and the quadrupole splitting of a recoilless emitted γ ray. These properties allow an identification and a detailed discussion of the bond structure in many compounds. Chemical effects of nuclear reactions and nuclear transformations are also detectable by the structure of the recoilless emission spectrum. The basic principles of these applications are discussed and illustrated by a few typical measurements. (auth)

21906 THE BORON-HYDROGEN BOND-ANALYSIS OF THE FUNDAMENTAL VIBRATIONAL SPECTRA OF THE ISOTOPIC BOROHYDRIDE IONS, KINETIC ISOTOPE EFFECTS UPON THE HYDROLYSIS OF PYRIDINE ARYLBORANES AND THE CALCULATION OF KINETIC ISOTOPE EFFECTS FOR THE HYDROLYSIS OF ISOTOPIC BOROHYDRIDE IONS. Kenson, Robert Earl. Lafayette, Ind., Purdue Univ., 1965. 254p. Thesis.

Fundamental vibrational spectra of the isotopically substituted borohydride ions were calculated. The F and G method of Wilson was used to solve the eigenvalue problem with a Fortran program written for use with an IBM 7094 digital computer. Symmetry force constants for the problem were constructed from valence force constants determined from analysis of the Raman spectrum of the borohydride and borodeuteride ions in liquid ammonia solutions. Statistical mechanical calculations of the stabilities of the ions BH_4^-, BH_3D^-, $BH_2D_2^-$, BHD_3^- and BD_4^- were accomplished by use of the calculated fundamental vibrational frequencies and the known molecular constants. The $F_{BD_4^-} - F_{BH_4^-}$ is -3.7 kilocalories, showing the borodeuteride ion to be the most stable of the BH_XD_{4-X} species, as it is totally isotopically substituted and has the lowest zero point vibrational energy. The variation of k_H/k_D with the para substituent for the hydrolysis of a series of pyridine arylboranes was investigated by a competitive technique. The values obtained range from $k_H/k_D = 1.41$ for pyridine para-methoxy phenylborane, to $k_H/k_D = 1.15$ for pyridine para-methyl phenylborane, to $k_H/k_D = .96$ for pyridine phenylborane, and to $k_H/k_D = .92$ for pyridine para-chloro phenylborane. The inverse isotope effect is attributed to a large secondary isotope effect of the deuterium or hydrogen atom attached to boron that is not involved directly in the rate determining step of proton transfer. The change in the isotope effect with para substituent is then attributed to an electronic effect on the vibrational force constant of this secondary boron-hydrogen or boron-deuterium bond in the transition state. This was supported by the fact that k_H/k_D increased as the boron-hydrogen bond stretching frequency decreased for this series of pyridine arylboranes. The isotope effects were measured at 25°C and standard deviations of the measurements calculated as well as k_H/k_D. The various kinetic isotope effects for the isotopically substituted borohydride ions, both the competitive intermolecular and intramolecular effects, were calculated from Absolute Rate Theory equations. The ground state molecular properties and those of the model chosen for the transition state were calculated by use of a digital computer and converted within the computer program into the values for k_H/k_D. The model for the transition state was BH_5, in which a proton approaches the borohydride ion along one of its B-H bond axes. Force fields were assumed for the transition state from ground state models, and varied until a good fit to the experimental k_H/k_D of 0.70 for borohydride versus borodeuteride hydrolysis was obtained. The model also fitted the low-temperature k_H/k_D values obtained experimentally. (Diss. Abstr.)

Inorganic, Organic, and Physical Chemistry

Refer also to abstracts 21855, 21963, 21970, 22212, 22841, and 23269.

21907 (AGN-8215) ALKALI METALS EVALUATION PROGRAM. Quarterly Progress Report, October 1-December 31, 1966. Achener, P. Y. (Aerojet-General Corp., San Ramon, Calif. Nuclear Products and Services Group). Feb. 1967. Contract AT(04-3)-368. 48p. Dep. CFSTI.

The thermodynamic and transport properties of Cs, Rb, and K were determined. Developments in the determination of thermodynamic and transport properties of alkali metals for heat pipe applications, including vapor pressure of Li, surface tension and contact angle of Li, liquid viscosity of Na, liquid specific heat of Li and Na, and liquid thermal conductivity of Li and Na are reported. (P.C.H.)

21908 (COO-716-027) PREPARATION, CHARACTERIZATION, AND SOME THERMODYNAMIC PROPERTIES OF LANTHANUM-OXIDE-CARBIDE, $La_2O_2C_2$. Butherus, A. Duane; Eick, Harry A. (Michigan State Univ., East Lansing. Dept. of Chemistry). Mar. 1967. Contract AT(11-1)-716. 10p. (CONF-670502-3). Dep. mn. CFSTI $3.00 cy, $0.65 mn.

From 6th Rare Earth Research Conference, Gatlinburg, Tenn.

A lanthanum-oxide-carbide of the general formula $La_2O_2C_2$ has been prepared by the reaction of molten lanthanum metal with carbon monoxide, by the reaction of lanthanum metal with the sesquioxide and carbon, by the reaction of lanthanum dicarbide with the sesquioxide and carbon, and by the reaction of sesquioxide with graphite. All reactions were carried out in a carbon monoxide atmosphere. Some of the preparations which were zone refined by slow passage of an arc over an approximately 7 cm long sample produced a crystalline phase which both x-ray powder diffraction and micrographic analysis indicated to be monophasic. Analysis of this specimen for total carbon, free carbon, and metal indicated the composition mentioned previously. Vapor phase chromatographic analysis of the acid hydrolysis product indicates the principal species to be acetylene. A carbon monoxide equilibration study undertaken on the reaction, $La_2O_3(s) + 3C(s) = La_2O_2C_2(s) + CO(g)$ in a closed constant volume system produced the following data: $\Delta H^0_{298} = 82.16 \pm 2.0$ kcal/mole, and $\Delta S^0_{298} = 36.67 \pm 3.5$ eu. By combining these values with the appropriate thermodynamic data, a heat of formation of -313.6 ± 3.0 kcal/mole is calculated for this phase. A third heat law calculated with tabulated free energy functions for the sesquioxide, graphite, and carbon monoxide, and estimated for the oxide-carbide species is in agreement with the values cited above. The stability of this phase will be compared to that of an analogous neodymium species. (auth)

21909 (CU-3712-03) DEFECTS IN CRYSTALS. Annual Report, June 1, 1966–March 1, 1967. Nowick, A. S. (Columbia Univ., New York. Henry Krumb School of Mines). Contract AT(30-1)-3712. 33p. Dep. mn. CFSTI $3.00 cy, $0.65 mn.

Equipment was developed for internal friction studies. The specimen resonator, electrode assembly, electronic system, thermal system, vacuum system, and crystal-cutting apparatus are described. The theory of deviations from the Arrhenius equation for diffusion is discussed. It is shown that it is possible that the entire curvature of the Arrhenius plot for diffusion in fcc metals can be attributed to an inherent curvature rather than to the onset of a second mechanism at low temperatures. Thermal expansion measurements on noncubic crystals by dilatometry and x-ray microscopy were interpreted. In crystals possessing a major symmetry axis (hexagonal, tetragonal, or trigonal) experiments on combined macroscopic and microscopic thermal expansion gave two quantities, one combination of which gives the vacancy concentration. (M.C.G.)

21910 (EUR-3278.d) EIN STROEMUNGSKALORIMETER ZUR BESTIMMUNG DER MOLWAERMEN VON DAEMPFEN HOCHSIEDENDER FLUESSIGKEITEN. (A Flow Calorimeter for Determining the Molecular Heat of High-Boiler Liquid Vapors). Reiter, F. W. (European Atomic Energy Community, Ispra (Italy). Joint Nuclear Research Center). Mar. 1967. 30p. (In German). Dep. mn.

A streaming method is described in which the molar heats of vapors of liquids with high boiling points up to 400°C can be measured. The molar heats of benzene, diphenyl, and o- and m-terphenyl were determined in a temperature range corresponding to vapor pressures from 0.05 to 2 atm. The experimental error is estimated at 2 to 3%. (auth)

21911 (IA-1087) METAL CHLORIDE COMPLEXES STUDIED BY ION EXCHANGE AND SOLVENT EXTRACTION METHODS. Marcus, Y. (Israel Atomic Energy Commission, Yavne. Soreq Nuclear Research Center). Dec. 1966. 145p. Dep. mn.

The application of ion exchange and solvent extraction methods to the study of chloride complex formation in solution is reviewed, up till the end of 1965. For each complex-forming metallic element (and each oxidation state, where applicable), the results of studies of cation exchange chelate extraction, extraction by solvating solvents, extraction by long-chain amines, and anion exchange are critically discussed and correlated. An attempt was made to determine from the data the species formed in aqueous chloride solutions in various concentration ranges. (415 references.) (auth

21912 (INP-507/PL) O PROCESIE MAGNETYCZNEJ RELAKSACJI PROTONOW W NIEKTORYCH CIECZACH. (Proton Magnetic Relaxation in Some Liquids). Hennel, Jacek W. (Institute of Nuclear Physics, Krakow (Poland)). Dec. 1966. 70p. (In Polish). Dep.

Proton spin-lattice relaxation time T_1 in the liquid state of NH_3, H_2S and H_2S-D_2S mixture was measured in a wide range of temperature. In all the liquids, a maximum of T_1 was found. This behavior is explained using Hubbard's theory as due to dipolar and spin-rotational interaction. (auth)

21913 (LA-3657) FURTHER TESTS OF DILUTE SOLUTION EQUATIONS AND THERMODYNAMIC RELATIONSHIPS: THE VAPOR PRESSURE OF CADMIUM OVER LIQUID ALLOYS CONTAINING SMALL AMOUNTS OF LEAD. Swofford, Harold S. Jr.; Elliott, Guy R. B. (Los Alamos Scientific Lab., N. Mex.). Oct. 1, 1965. Contract W-7405-eng-36. 24p. Dep.mn. CFSTI $3.00 cy, $0.65 mn.

With Appendix in Reply to O'Keeffe's Comments "On the Validity of Raoult's and Henry's Laws as Limiting Laws for Dilute Solutions." Elliott, Guy R. B.; Swofford, Harold S. Jr.; Conant, Donald R.

The vapor pressure of cadmium over molten lead–cadmium alloys in the dilute lead range has been measured by the isopiestic balance technique. In the range 0.004 to 0.010 mole fraction lead, the cadmium vapor pressures at 780°K obey the relationship $P_{Cd\ alloyed}/P_{Cd\ pure} = 1 - 1.63\ N_{Pb}$ when N_{Pb} is the mole fraction of lead in solution. The solvent thus shows strong negative deviation from Raoult's law in a concentration region where it is conventional to assume, based on thermodynamic arguments, that Raoult's law would be obeyed or at least closely approached. Some of the implications of this result are discussed. At larger lead concentrations an increasing curvature becomes observable, and from 0.015 to 0.032 mole fraction lead the relationship $P_{Cd\ alloyed}/P_{Cd\ pure} = 1 - 2.04\ N_{Pb} + 33.0\ N_{Pb}^2$ is obeyed, the activity becoming positive to Raoult's law at 0.9683 mole fraction cadmium. (auth)

21914 (LA-3668) HOT-WIRE IGNITION OF SECONDARY EXPLOSIVES IN SQUIBS. Reithel, Robert J. (Los Alamos Scientific Lab., N. Mex.). Jan. 30, 1964. Contract W-7405-eng-36. 23p. Dep. mn. CFSTI $3.00 cy, $0.65 mn.

Electrically heated platinum bridgewires were used to ignite secondary explosives in pressure cartridges. These cartridges, containing only RDX or HMX, were ignited at currents ranging from a fraction of 1 to over 50 A in times ranging from less than 1 msec to more than 1 sec. HMX-loaded cartridges functioned after being subjected to a temperature of 190°C for many hours. When subjected to rapid heating, these pressure cartridges did not undergo autoignition until reaching 240°C. The safe current, i.e., that current to which the bridgewire may be subjected for 1 min without igniting the explosive, of these pressure cartridges may be adjusted to values as large as 10 A by an appropriate choice of the bridgewire diameter. The pressure cartridges may be converted to detonators by using the evolved gases to drive a flying plate against a second charge of secondary explosive. (auth)

21915 (NIM-44) ZERO POINT OF CHARGE OF URANIUM DIOXIDE AND URANINITE. Carlton, Claire J. E.; Laxen, P. A. (National Inst. for Metallurgy, Johannesburg (South Africa)). June 27, 1966. 13p. Dep. mn.

The zero point of charge (zpc) of a mineral in contact with a solution occurs when the positive and negative charges on the solid surface are equal. For oxides, the value of the zpc is the pH of the solution in which the mineral surface has no net charge. This is a useful parameter in studies of flotation and dissolution. The zpc's of UO_2 and uraninite were determined by potentiometric titrations. The values obtained were 4.8 and 6.6, respectively. (auth)

21916 (NP-16421) BIBLIOGRAPHY ON THE HIGH TEMPERATURE CHEMISTRY AND PHYSICS OF GASES AND PLASMAS. No. 20. Brewer, L. (comp.) (California Univ., Berkeley. International Union of Pure and Applied Chemistry. Commission on High Temperatures and Refractories). Sept. 30, 1966. 32p. NBS, Washington, D. C. Free.

A total of 308 references is given to U.S. and foreign journals and reports published from 1963 through 1966. 187 of the references are on spectroscopy in high-temperature chemistry and the other 121 are on reactions between gases and condensed phases. (P.C.H.)

21917 (ORNL-4076) REACTOR CHEMISTRY DIVISION ANNUAL PROGRESS REPORT FOR PERIOD ENDING DECEMBER 31, 1966. (Oak Ridge National Lab., Tenn.). Mar. 1967. Contract W-7405-eng-26. 202p. Dep. mn. CFSTI $3.00 cy, $0.65 mn.

Research progress in reactor chemistry is reported under 5 headings: molten-salt reactors, aqueous reactors, gas-cooled reactors, other ORNL programs, and nuclear safety. Separate abstracts were prepared for each of the 5 headings. (M.C.G.)

For abstracts of individual sections see: 21918, 21919, 21970, 22411, and 22841.

21918 (ORNL-4076, pp 1-54) MOLTEN-SALT REACTORS. (Oak Ridge National Lab., Tenn.).

Research is reported on: phase equilibria and crystallography, chemical studies of molten salts, separation chemistry and irradiation behavior, and direct support for MSRE. (M.C.G.)

21919 (ORNL-4076, pp 81-115) GAS-COOLED REACTORS. (Oak Ridge National Lab., Tenn.).

Research progress is reported on: diffusion processes, behavior of graphite with reactive gases, irradiation behavior of high-temperature fuel materials, and behavior of high-temperature materials under irradiation. (M.C.G.)

21920 (ORNL-4103) X-RAY DIFFRACTION DATA ON LIQUID 2,2-DIMETHYLPROPANE (NEOPENTANE) AT 25°C. Narten, A. H.; Levy, H. A. (Oak Ridge National Lab., Tenn.). Apr. 1967. Contract W-7405-eng-26. 29p. Dep. mn. CFSTI $3.00 cy, $0.65 mn.

The scattering of x-rays from the free surface of liquid neopentane in equilibrium with its vapor was measured at 25°C. The diffractometer used was specially designed for the study of liquid structure. Both the raw data and the intensity and radial distribution functions derived from them are presented in tabulated form. Intramolecular distances obtained are in agreement with those derived from gas diffraction experiments. (auth)

21921 (RT-CHI-(66)39) STUDIES ON THE HYDROLYSIS OF METAL IONS 57. THE HYDROLYSIS OF CERIUM(IV) IN 3 M(Na)NO_3 MEDIUM. Danesi, P. R. (Comitato Nazionale per l'Energia Nucleare, Rome (Italy)). 1966. 34p. Dep. mn.

The hydrolysis of Ce(IV) ions was studied at 25°C in the medium, 3M (Na)NO_3 · $[H^+]$ = h was measured with a glass electrode and $[Ce^{4+}]$ = b with a gold redox electrode. The $[Ce(IV)]_{tot}$ was varied from 10 to 100 mmole. There was evidence of slow reactions. The data were treated with the computer program LETAGROP with independent adjustment of analytical errors. By writing the reactions as: $q\ Ce^{4+} + pH_2O = Ce_q(OH)_p^{(4q-p)+} + pH^+$ and the equi-

librium constants as $\beta_{p,q}$, the best combination of complexes and equilibrium constants was found to be: $Ce_2(OH)_4^{4+}$, $\beta_{2,2} = (5.1 \pm 0.3)10^{-2}$, $Ce_2(OH)_4^{4+}$, $\beta_{4,2} = (2.3 \pm 0.3)10^{-3}$, $Ce_6(OH)_{12}^{12+}$, $\beta_{12,6} = (1.36 \pm 0.06)10^{-2}$. (auth)

21922 (AWRE-Trans-52) ELECTRICAL CONDUCTIVITY OF METALS: AN EMPIRICAL RELATION. Klein, A. Translated by F. E. Wallwork (Atomic Weapons Research Establishment, Aldermaston, Eng.), from Stud. Cercet. Fiz., 15: 389-94(1964). 9p. Dep. mn. CFSTI $3.00 cy, $0.65 mn. HMSO 6s. 0d.

Attempts were made to find empirical relations for the electric conductivity of metals. Groups of metals were selected from the periodic system elements and the product of the conductivity and density of the metals was calculated for two different temperatures. For each temperature a polynomial in Z was found that approximates to the values calculated for the product. It was found that polynomials with a significant structure were found which can be correlated with the atomic structure of the metals, while the coefficient depending on temperature can be separated from the expression depending on Z. (P.C.H.)

21923 COMPLEXATION OF URANYL WITH PHENOLIC LIGANDS. Bartusek, M. (Purkyne Univ., Brno). J. Inorg. Nucl. Chem., 29: 1089-95(Apr. 1967).

Complex systems involving uranyl and phenols were studied by potentiometric methods in dilute aqueous solutions containing an excess of the phenolic reagent. Equilibrium constants are given and some general rules for uranyl complexing with different types of phenols are outlined. (auth)

21924 ISOTOPE EFFECT OF HYDROGEN ON THE OXIDATION OF BENZENE TO PHENOL. Hotta, Hiroshi (Japan Atomic Energy Research Inst., Tokyo). Bull. Chem. Soc. Jap., 40: 687-8(Mar. 1967).

The oxidation of an equimolar mixture of C_6H_6 and C_6D_6 was studied in order to determine the mechanism of phenol formation. The isotope effect on the rate constant ratio of the reaction, K_H/K_D, was estimated from the isotopic composition of the phenol produced, using the equation $K_H/K_D = [(C_6D_6/C_6H_6) \times (C_6H_5OH/C_6D_5OH)]$, where $(C_6/D_6)/(C_6H_6)$ is the initial mole ratio of the benzene mixture. The oxidation was initiated by Fenton's reagent at 20 and 70°C. The values of K_H/K_D were 1.25 ± 0.02 at 20°C and 1.37 ± 0.02 at 70°C. The higher value at 70°C than at 20°C indicated that the oxidation process at 70°C contains a reaction that gives a higher isotope effect than that at 20°C. The yield of phenol indicated that the oxidation is apparently a non-chain reaction at 20°C and a chain reaction at 70°C. These facts regarding the value of K_H/K_D and the yield of phenol at both temperatures support an abstraction reaction instead of an addition reaction. (D.H.M.)

21925 STUDIES ON SOME METAL-HYDRAZINE COMPLEXES. Athavale, V. T.; Iyer, C. S. Padmanabha (Atomic Energy Establishment, Trombay, India). J. Inorg. Nucl. Chem., 29: 1003-12(Apr. 1967).

Under different conditions of preparation, uranyl chloride reacted with hydrazine giving rise to hydrated and/or hydroxylated species of compositions $(UO_2Cl_2)_2 \cdot N_2H_4 \cdot 6H_2O$; $[UO_2(OH)Cl]_2 \cdot 3N_2H_4$ and $[UO_2(OH)Cl]_2 \cdot N_2H_4 \cdot 6H_2O$, whereas from uranyl sulphate the normal complex of composition $UO_2SO_4 \cdot 2N_2H_4$ was obtained except in the case when aqueous solutions of uranyl sulphate and hydrazine sulphate were employed. The normal hydrazine complexes of thorium, cerium, and nickel of compositions $Th(SO_4)_2 \cdot 2N_2H_4$, $Ce(SO_4)_2 \cdot 2N_2H_4$ and $NiSO_4 \cdot 3N_2H_4$ were also prepared. All these compounds were studied by thermogravimetry, differential thermal analysis, x-ray and ir analyses. The order of stabilities of the hydrazine complexes with the matallic sulphates are discussed. (auth)

21926 ADSORPTION MEASUREMENT DURING HYDROGEN-DEUTERIUM EQUILIBRATION OVER NICKEL CATALYST. Otsuka, Kiyoshi; Keii, Tominaga (Tokyo Inst. of Tech.). Nippon Kagaku Zasshi, 88: 320-5(Mar. 1967). (In Japanese).

The hydrogen-deuterium equilibration over nickel was studied by measuring adsorption during reaction according to Tamaru's method. The method could not be applied for the reaction with silica supported nickel catalyst, since the silica itself adsorbed a considerable amount of hydrogen at low temperatures suitable for the reaction. On a nickel powder catalyst the equilibration proceeded moderately at -100°C. The order of reaction was 0.7 to 1.0 with respect to the total pressure, and the activation energy was 6.3 kcal/mol. It was found by Tamaru's method that the adsorbed hydrogen did not exchange with its gaseous isotope in the course of the equilibration. Then, the amount of active site may be less than one percent of the surface of the catalyst. Measuring the adsorption of hydrogen at increasing temperature stepwise from -195 to 0°C, three types of adsorbed hydrogen were suggested on nickel surface: a reversibly adsorbed molecular hydrogen at ca. -195°C, and other two types exchangeable with its isotope at -78 and -45°C, respectively. (auth)

21927 ELECTROMETRIC DETERMINATION OF STABILITY CONSTANTS OF URANYL-CHLORIDE AND URANYL-NITRATE COMPLEXES WITH pCl-STAT. Ohashi, Hiroshi; Morozumi, Takashi (Hokkaido Univ., Sapporo). Nippon Genshiryoku Gakkaishi, 9: 65-71(Feb. 1967). (In Japanese).

An electrochemical pCl-stat was devised to determine the stability constants of UO_2Cl^+ and $UO_2NO_3^+$ ion complexes in the aqueous solutions of KNO_3 and $NaNO_3$-$NaClO_4$ containing minor amounts of Cl^- ion at 25°C. The stability constant K_c of UO_2Cl^+ at various ionic strengths μ was estimated from the amount of UO_2Cl^+ ion obtained by the integration of the current-time curve of the pCl-stat following the addition of a given amount of uranyl salt. The stability constant at higher ionic strengths is relatively small, e.g., K_c = 2.42, 1.40, and 0.89 at μ = 0.54, 0.82, and 1.06, respectively. However, the thermodynamic stability constant K_a at μ = 0 obtained by extrapolation of the curve of K_c against μ, resulted in the remarkably high value of 15. The stability constants of $UO_2NO_3^+$ were also determined by measuring the K_c values of UO_2Cl^+ as a function of compositions at constant μ in mixed solutions of $NaNO_3$ and $NaClO_4$. The observed results were 0.37, 0.20, and 0.19 at μ = 0.54, 0.82 and 1.06, respectively. (auth)

21928 REACTION BETWEEN TUNGSTEN AND MOLTEN ALUMINUM OR SILICON OXIDES. Kostikov, V. I.; Mitin, B. S.; Roitberg, M. B. (Moscow Inst. of Steels and Alloys). Izv. Akad. Nauk SSSR, Neorg. Mater., 2: 1599-1603(Sept. 1966). (In Russian).

The reaction between tungsten and molten aluminum or silicon oxides at 2300 to 2700°C has been investigated. It was found that the reaction was complex and involved the following processes: reduction of oxides by tungsten, vaporization of reduction products, reaction between the reduction products in the vapor phase, and vaporization and dissociation of oxides. The main factor determining the weight loss in the tungsten-refractory oxide system is vaporization of tungsten oxide. The time dependence of weight loss during the reaction between tungsten and aluminum oxide is linear, reaching 1.3 q after 15 min. The time dependence for tungsten-silicon oxide reaction follows a similar pattern but the weight loss is less intensive. (ATD)

21929 ADSORPTION, ABSORPTION, AND DEGASSING IN THE OXYGEN-NIOBIUM SYSTEM AT VERY LOW PRESSURE. Pasternak, R. A.; Evans, B. (Stanford Research Inst., Menlo Park, Calif.). J. Electrochem. Soc., 114: 452-7(May 1967).

The interaction of low-pressure oxygen with niobium was investigated at temperatures between 300 to 2100°K. Four main kinetic patterns can be distinguished. At temperatures close to 300°K adsorption proceeds to the formation of a saturated surface layer. At intermediate temperatures (about 500 to 800°K) a thin oxide layer is formed; simultaneously oxygen dissolves and diffuses into the metal. At higher temperatures (800 to 1700°K) oxygen dissolves rapidly and irreversibly; the observed kinetics can be explained by a surface mechanism involving two adsorption states. Finally, at very high temperatures (1700°K and higher) niobium oxides evaporate from an oxygen-niobium solution. The kinetics of evaporation indicate that a mixture of NbO_2 and NbO evolves, the composition of which shifts from the former to the latter with decreasing oxygen concentration. (auth)

21930 THE RELATIVE SIGN OF THE ^{13}C-^{29}Si COUPLING CONSTANT IN TETRAMETHYLSILANE. Dean, R. R.; McFarlane, W. (National Physical Lab., Teddington, Eng.). Mol. Phys., 12: 289-91(1967).

It was suggested that the $^{13}C-^{29}Si$ coupling constant in tetramethylsilane is negative. Experiments are described to determine the sign of this coupling constant relative to the directly bonded $^{13}C-H$ coupling. The experiments were performed using a spectrometer operating at 100 Mc/s in the proton region, and equipped with field-frequency stabilization. The transmitter coil was modified so that in addition to the ^1H frequency it could be tuned to either the ^{13}C resonant frequency or the ^{29}Si resonant frequency. The sample contained a small amount of benzene, to act as a control signal for actuating the feedback loop of the spectrometer. The ^1H spectrum of tetramethylsilane at 100 Mc/s is reproduced (showing exaggerated ^{13}C and ^{29}Si intensities). It was found that the sign of the $^{13}C-^{29}Si$ coupling constant is opposite to that of the $^{29}Si-^1H$ coupling constant. The magnitude of the $^{29}Si-^{13}C$ coupling constant was also confirmed, and it was shown that its sign (taking into account the negative moment of ^{29}Si) was opposite to that of the directly bonded $^{13}C-H$ coupling constant. Values for the $^{13}C-H$, $^{13}C-^{29}Si$, and $^{29}Si-^1H$ coupling constants are tabulated. (UK)

21931 ^{222}Rn OR ^{220}Rn DIFFUSION IN VARIOUS SUBSTANCES. Porstendoerfer, J. (Univ., Giessen, Ger.). pp 48-52 of Biophysikalische Probleme der Strahlenwirkung. Muth, H. Stuttgart, Georg Thieme Verlag, 1966. (In German).

The diffusion constant of Rn in paraffin, lard, and styropor was measured at 20°C using ^{220}Rn and ^{222}Rn. The diffusion constant of

^{222}Rn was assumed equal to that of ^{220}Rn. The experimental device and technique are outlined and the results are shown graphically. The values obtained for the diffusion constants were 8×10^{-5} cm²/min for paraffin, 1.9×10^{-4} cm²/min for lard, and 3.4×10^{-2} cm/min for styropor. An error of 10 to 15% was estimated from the oscillations of the value. (J.S.R.)

21932 HYDROLYSIS OF URANIUM IONS AT ELEVATED TEMPERATURES. Ryzhenko, B. N.; Naumov, G. B.; Goglev, V. S. (Vernadskii Inst. of Geochemistry and Analytical Chemistry, Moscow). Geokhimiya, No. 4, 413-17(Apr. 1967). (In Russian).

An analysis of various mechanisms of uranyl-ion hydrolysis was carried out. It is shown that at certain uranium concentrations a change of the hydrolysis mechanism occurs and experimental data obtained for solutions with its high concentration cannot directly be used in studying uranium behavior in natural waters with its low concentration. The constant of the first step of uranyl-ion hydrolysis was determined by the method of electrical conductivity at temperatures of 100 to 200°C. The temperature rise moves the boundary of mechanism change to a region of higher uranium concentration. (auth)

21933 MEASUREMENT OF VISCOSITY OF MIXTURES OF DIPHENYL, OMP, AND HIGH BOILING RESIDUE. Termine, G.; Zanelli, S. (Univ., Pisa, Italy). Riv. Ing. Nucl., 3: 860-7 (Sept.-Dec. 1965). (In Italian).

Viscosity was measured of mixtures containing various percentages of biphenyl, OMP, and high-boiling residues. Experimental devices and techniques are outlined and the results are graphed. Results show that the viscosity of all the organic fluids studied follow substantially the Arrhenius law. A graph is given by which it is possible to obtain at all temperatures the viscosity of the various components pure or in mixture. In an appendix the accuracy of the measurements, the operational conditions of the test, and the determination of the variants are outlined. (J.S.R.)

21934 THE ^{55}Mn NUCLEAR MAGNETIC RESONANCE SPECTRA OF ALKYL- AND ACYLMANGANESEPENTACARBONYLS AND RELATED COMPOUNDS. Calderazzo, F.; Lucken, E. A. C.; Williams, D. F. (Cyanamid European Research Inst., Geneva). J. Chem. Soc. (A), No. 1, 154-8(1967).

The ^{55}Mn nuclear magnetic resonance spectra of alkyl- and acylmanganese pentacarbonyls and related compounds in solution in tetrahydrofuran have been measured at a frequency of 14.858 Mc/s. The observed chemical shifts cover a range of 1020 to 2780 ppM to the high field of an aqueous solution of potassium permanganate, the line-widths are in general large owing to quadrupole relaxation. The nuclear magnetic resonance data are interpreted in terms of the bonding in these compounds. (auth)

21935 ^{59}Co NUCLEAR MAGNETIC RESONANCE OF ORGANOCOBALT COMPOUNDS. Lucken, E. A. C.; Noack, K.; Williams, D. F. (Cyanamid European Research Inst., Geneva). J. Chem. Soc. (A), No. 1, 148-54(1967).

The ^{59}Co nuclear magnetic resonance spectra of cobalticenium chloride, octacarbonyldicobalt, dodecacarbonyltetracobalt, octacarbonylmercurydicobalt, dicarbonylcyclopentadienylcobalt, nitrosyltricarbonylcobalt, and the hydrides and sodium salts of the tetracarbonylcobaltate and tetrakis(trifluorophosphine)cobaltate anions have been measured in solution in various solvents. The chemical shift of the cobalticenium ion is in excellent agreement with that predicted by ligand-field theory and the chemical shifts of the two cobaltate ions and the nitrosyl provide good evidence for metal to ligand donor–acceptor π-bonding. The π-bonding abilities of the ligands are in the order nitrosyl > carbonyl > trifluorophosphine. Hyperfine structure was observed from the ^{13}C nucleus in the sodium tetracarbonyl cobaltate and from the ^{31}P and ^{19}F nuclei in potassium tetrakis(trifluorophosphine)cobaltate and the magnitudes of the coupling constants suggest a σ-bond order Co–P > Co–C. The sharp lines of the two cobaltates show that the cobalt atom is in the tetrahedral configuration; remaining compounds have the broad lines expected from a nucleus with spin $\frac{7}{2}$ in a non-cubic environment. (auth)

21936 INFRARED SPECTRA OF SOME 5-AMINOTETRAZOLES AND THEIR DEUTERATED DERIVATIVES. Jonassen, Hans B.; Paukert, Thomas; Henry, Ronald A. (Tulane Univ., New Orleans. Naval Ordnance Test Station, China Lake, Calif.). Appl. Spectros., 21: 89-91(Mar.-Apr. 1967).

Spectra of solid 5-aminotetrazoles and their deuterated derivatives in mulls and KBr disks are presented. It was possible to assign regions for NH and ND stretching, bending, and rocking modes; ring N=N and C=N frequencies; and exo CN stretching modes. (auth)

21937 URANYL NITRATE HEXAHYDRATE–TRIPHENYLARSINE SYSTEM. Zarli, B.; Panattoni, C. (Univ. of Padua). Inorg. Nucl. Chem. Lett., 3: 111-12(Apr. 1967).

The affinity of uranium towards neutral organic ligands containing arsenic donor atoms is considered. Unsuccessful attempts were made to prepare compounds of U(IV) with organic arsines. The studies described appear to indicate that U(VI) does not form U–As coordinative bonds. The ligands studied were o-phenylenebis(dimethylarsine), o-methoxyphenyldimethylarsine, o-dimethylaminophenyldimethylarsine, and triphenylarsine. Uranyl acetate and chloride were inert towards all these ligands. Uranyl nitrate caused decomposition of the first three of these ligands, but reacted with the fourth to give a compound having two As for each U atom. This compound is described, including its infrared spectra. Arsine oxide appears to bind the uranyl group in this case (formula $UO_2(NO_3)_2 \cdot 2Ph_3AsO$). (UK)

21938 BASIC PHYSICAL RESEARCH PROGRAMS. pp 111-224 of Fundamental Nuclear Energy Research, 1966. Washington, D. C., Atomic Energy Commission, 1966.

Summaries of research carried out by the AEC during the past year are presented for the following areas: metallurgy and materials, chemistry, high energy physics, low energy physics, mathematics and computers, and thermonuclear research. (M.O.W.)

21939 HALOGEN-CONTAINING PLASTIC SCINTILLATORS. Chernobai, A. V.; Zaplesnichenko, G. P.; Vershinina, S. P.; Kolesnikov, L. N. Zh. Prikl. Spektrosk., Akad. Nauk BSSR, 6: 90-4 (Jan. 1967). (In Russian).

Plastic scintillators containing halogen and consisting of a solid solution of luminescent admixtures terphenyl and POPOP in polystyrene are described. Hexachlorobenzene, dibromobenzene, diiodobenzene, chlorostyrene, alkali halogenides, etc., were used as components containing halogen. The scintillator samples were obtained by means of block high temperature polymerization. The light output and dosimetric characteristics of scintillators were studied in dependence on the nature of compensators and their concentration. As a result of the investigations new air-equivalent detectors were obtained for dosimetry over a wide energy range (35 to 125 keV). (auth)

21940 COMPLEXES OF URANYL WITH PHENOLIC LIGANDS. VIII. POTENTIOMETRIC INVESTIGATION OF URANYL COMPLEXES WITH p-NITROPHENOL, 4-NITROPYROCATECHOL, 2,3-DIHYDROXYNAPHTHALENE, ALIZARIN S, PYROGALLOL CARBOXYLIC ACID, PYROGALLOL SULFONIC ACID, AND WITH MIXTURES OF TIRON AND SULFOSALICYLIC ACID. Bartusek, M. (Purkyne Univ., Brno). Collect. Czech. Chem. Commun., 32: 757-73(Feb. 1967). (In German).

With the help of potentiometric alkalimetric titration, the formation of complexes in uranyl salt solutions ($\sim 10^{-3}$M) with excess phenolic ligands was investigated in a broad pH range. For the complexes of p-nitrophenol, 4-nitropyrocatechol, and 2,3-dihydroxynaphthalene the values of the corresponding stability constants were determined. (tr-auth)

21941 CONTRIBUTION TO THE KNOWLEDGE OF THE ELECTROCHEMISTRY OF URANIUM IN MOLTEN LiCl–KCl EUTECTIC. I. THE REDOX POTENTIAL OF THE COUPLE U(IV)/U(III). Caligara, F.; Martinot, L.; Duyckaerts, G. (Univ. of Liege). Bull. Soc. Chim. Belges, 76: 5-14(Jan.-Feb. 1967).

Careful measurements of the redox potential of the system U(IV)/U(III) in molten LiCl–KCl eutectic were carried out in glove-boxes with dry and inert atmosphere. The emf of the cell was measured by a high impedance electronic voltmeter. Efforts were directed to prevent even the slightest oxidation of the uranium species involved in the measurements. (auth)

21942 CONTRIBUTION TO THE KNOWLEDGE OF THE ELECTROCHEMISTRY OF URANIUM IN MOLTEN LiCl–KCl EUTECTIC. II. CHRONOPOTENTIOMETRIC STUDY OF THE REACTION U(IV) + e ⇌ U(III) AND MEASUREMENT OF THE DIFFUSION COEFFICIENT. Caligara, F.; Martinot, L.; Duyckaerts, G. (Univ. of Liege). Bull. Soc. Chim. Belges, 76: 15-25(Jan.-Feb. 1967).

The reaction U(IV) + e ⇌ U(III) in molten LiCl–KCl eutectic was investigated by means of chronopotentiometry. The diffusion coefficient of U(IV) passed from 4.46×10^{-6} to 12.15×10^{-6} cm²/sec when the temperature increased from 400 to 500°C. The diffusion coefficient of U(III) passed from 4.14×10^{-6} to 13.62×10^{-6} cm²/sec when the temperature increased from 400 to 550°C. The mechanism of diffusion is discussed and the hypothesis is put forward that for each ion there is a temperature at which the diffusion takes place according to the viscous flow mechanism. Some aspects of the kinetics of the reaction are also clarified. (auth)

21943 CONTRIBUTION TO THE KNOWLEDGE OF THE ELECTROCHEMISTRY OF URANIUM IN MOLTEN LiCl–KCl EUTECTIC. III. THE KINETICS OF THE REACTIONS U(IV) ⇌ U(III) AND U(III) ⇌ U(O). Caligara, F.; Martinot, L.; Duyckaerts,

G. (Univ. of Liege). Bull. Soc. Chim. Belges, 76: 26-32(Jan.-Feb. 1967).

The kinetics of the reactions U(IV) + e ⇌ U(III) and U(III) + 3e ⇌ U(O) in molten LiCl–KCl eutectic were investigated by means of Tafel lines. For the first reaction, the slope of the line was RT/F, both for reduction and oxidation, which indicated that the electron-transfer is not the rate determining step. The rate determining step is the rearrangement of the solvation shell, which followed the electron-transfer. The slope of the Tafel line, for the second reaction, is nearly zero; it is suggested that the great exchange current did not allow the attainment of the Tafel zone. (auth)

21944 THERMOCHEMICAL INVESTIGATION OF URANIUM TETRAFLUORIDE CRYSTAL HYDRATES AND THEIR DEHYDRATION PRODUCTS. Gagarinskii, Yu. V.; Khanaev, E. I. (Inst. of Inorganic Chemistry, Novosibirsk, USSR). Zh. Neorg. Khim., 12: 111-5(Jan. 1967). (In Russian).

During dehydration in vacuum all the investigated crystal hydrates of uranium tetrafluoride formed, as intermediate products, anhydrous uranium tetrafluoride in a metastable state. The heats of solution in hydrochloric acid (with the addition of H_3BO_3) of the metastable and stable forms of UF_4 and their crystal hydrates were determined. The heats of conversion of the metastable form of UF_4 into the stable form and the heats of hydration of the dehydrated uranium tetrafluoride in different states were calculated. It was discovered that the metastable form of UF_4, obtained from different crystal hydrates, have different heats of solution and heats of conversion to the stable form. From the earlier determined heat of the reaction $U_s + 2F_g + 2.5H_2O_l = UF_4 \cdot 2.5H_2O_s$, the heat of formation of UF_4 in the stable state was calculated. (tr-auth)

21945 THORIUM ACETATES. Molodkin, A. K.; Ivanova, O. M.; Skotnikova, G. A. Zh. Neorg. Khim., 12: 116-25(Jan. 1967). (In Russian).

Thorium tetraacetate $[Th(CH_3CO_2)_4]$, thorium guanidine hexaacetate $(CN_3H_6)_2[Th(CH_3CO_2)_6]$, and some hydroxide acetates of the tetra type $Th(OH)_m(CH_3CO_2)_{(4-m)} \cdot (n\ H_2)O$ were synthesized and some of their properties (density, electroconductivity of aqueous solutions, thermal stability, and infrared spectra) were studied. Hypotheses were made on their structure and the coordination number of Th. (tr-auth)

21946 INFRARED SPECTRA AND STRUCTURE OF COMPOUNDS PRODUCED BY ACETIC ACID AND U(VI) EXTRACTION BY TRIOCTYLAMINE SOLUTIONS. Lipovskii, A. A.; Guzina, M. G. Zh. Neorg. Khim., 12: 236-43(1967). (In Russian).

The infrared absorption spectra of complexes of uranyl triacetate with tetradecylammonium acetate and trioctylammonium acetate and their solutions in CCl_4 were measured. It was shown that the acetate groups are bound to the U atoms. Trioctylammonium-uranyl triacetate has its own ion series with weak H bonds. (D.H.M.)

21947 SYSTEMS OF ZrF_4–Na(K,Rb,Cs)F–H_2O. Tananaev, I. V.; Guzeeva, L. S. Zh. Neorg. Khim., 11: 1096-1102(May 1966). (In Russian).

The solubility in the system ZrF_4–MeF–H_2O (where Me = Na, K, Rb, and Cs) was studied at 25°C. It was established that in the stable solid phase in the system $MeZrF_5 \cdot H_2O$, $MeZrF_6$, Me_3ZrF_7 (Me = Na, K, and Rb) appeared as well as $Na_5Zr_2F_{13}$, the formation of which proceeds in succession with the increase of the concentration of MeF in the solution. The concentration boundary for the existence of these compounds was determined. Their individuality was confirmed analytically and microscopically. It was shown that $MeZrF_5 \cdot H_2O$ and Me_2ZrF_6 are dissolved in water simultaneously. The solubility in water of $MeZrF_5 \cdot H_2O$ was determined at 25°C and of Me_2ZrF_6 at 25, 50, and 75°C. (tr-auth)

21948 DITHIOCARBAMINATE U COMPLEXES. Muzyka, I. D.; Romanenko, E. D.; Tananaeva, N. N. (Inst. of General and Inorganic Chemistry, Kiev). Zh. Neorg. Khim., 11: 1214-19 (May 1966). (In Russian).

The adsorption of pyrrolidine dithiocarbaminate uranyl complexes, UO_2R_2, on solid sorbents was investigated. It was shown that the complexes UO_2R_2 have high adsorptivity equal to 600 mg of U on 1 g of sorbent. The adsorption of U was carried out from saturated solutions of other salts indifferent to the reagents. The possibility of complete purification of U compounds from micro-impurities of other metals and particularly Cd, one of the most harmful impurities in U, was shown. (tr-auth)

21949 BINUCLEAR OXALATE PENTACID TYPE URANYL COMPOUNDS. Shchelokov, R. N.; Belomestnykk, B. I. (Inst. of General and Inorganic Chemistry, Moscow). Zh. Neorg. Khim., 12: 93-100(Jan. 1967). (In Russian).

The capacity of the binuclear uranyl oxalate complexes of the pentacid type for crystallization from aqueous solutions increases, in dependence on the nature of the cation precipitants, in the series $NH_4^+ < Rb^+ < Cs^+ < K^+ < CN_3H_7^+ < C_2H_4(NH_3)_2^{2+}$. The Rb and Cs derived pentaoxylatediuranyl ions were prepared and methods for the synthesis of K and guanidino derived compounds are proposed. The thermal decomposition of the synthesized complexes was investigated. (tr-auth)

21950 STUDY OF THE BEHAVIOR OF UO_3 AND ITS HYDRATES IN SOLUTIONS BY MEANS OF HYDROXIDE ELECTRODES OF THE THIRD TYPE. Gryzin, Yu. I.; Koryttsev, K. Z. Zh. Neorg. Khim., 12: 101-7(Jan. 1967). (In Russian).

By means of potentiometric measurements with the hydroxide electrode the sizes of the activity product and the thermodynamic functions for the formation of $[UO_2OH]$ and $UO_2(OH)_2$ during utilization of UO_3 and its hydrates $UO_3 \cdot H_2O$ and $UO_3 \cdot 2H_2O$ as the basic phases were made more precise in the temperature interval from 20 to 50°C. It was shown that these values do not depend on the character of the UO_3 hydrate used as the basic phase, which during all cases appeared as uranyl hydroxides. This indicates the possibility of having a simple mechanism for the interaction of UO_3 and its hydrates with aqueous acid solutions. Hypotheses on the formation and state of UO_3 and its hydrates in solution and on the complex hydroxide compounds were confirmed quantitatively. (tr-auth)

21951 STUDIES OF URANYL FLUORIDE FORMATION BY ELECTRICAL CONDUCTIVITY METHOD. Vorontsova, A. A. Zh. Neorg. Khim., 12: 108-10(Jan. 1967). (In Russian).

The formation of uranyl fluoride in the systems MeF–$UO_2(NO_3)_2$–H_2O (where Me = Na or K) was studied by measurement of the electric conductivity of the system. The electroconductivity method showed two reactions: $UO_2^{2+} + F^- \rightarrow UO_2F^+$ and $UO_2F^+ + F^- \rightarrow UO_2F_2$. The addition of a fluoride ion to UO_2F_2 could not be detected. (J.S.R.)

21952 HEXAVALENT PLUTONIUM PHOSPHATES. Denotkina, R. G.; Shevchenko, V. B. Zh. Neorg. Khim., 12: 87-92 (Jan. 1967). (In Russian).

Three phosphate compounds of hexavalent Pu were separated: $NH_4PuO_2PO_4 \cdot 3H_2O$, $PuO_2HPO_4 \cdot 4H_2O$, and $PuO_2(H_2PO_4)_2 \cdot 3H_2O$. The conditions for their precipitation and some of their physical and chemical properties were established. By thermal decomposition of $NH_4PuO_2PO_4 \cdot 3H_2O$ and $NH_4UO_2PO_4 \cdot 3H_2O$ the water was gradually eliminated. The dehydration process of these salts is reversible. Ammonia uranyl phosphates and ammonia plutonyl phosphates changed their states during heating. (tr-auth)

21953 METAL–LIGAND OSCILLATIONS IN THE INFRARED ABSORPTION SPECTRA OF COMPLEXES WITH LIGHT CENTRAL ATOMS AND OXYGEN COORDINATION. II. BORON AND CARBON COMPOUNDS. Funck, Ernst (Univ., Freiburg i. B.). Ber. Bunsenges. Phys. Chem., 71: 170-81(Apr. 1967). (In German).

The antisymmetric stretching vibrations of the BO_4 group were studied in the infrared spectra of several boron compounds with fourfold coordination, sometimes by the effect of isotopic $^{10}B/^{11}B$ substitution. The vibration, which is threefold degenerate with T_d-symmetry, was mostly split, sometimes to a considerable extent. The spectra led to a mean wavenumber of 1030 cm^{-1}. Comparing the boron compounds with some isoelectronic carbon compounds showed the corresponding vibration of the CO_4 group occurred at a somewhat higher wavenumber, 1110 cm^{-1} respectively. This corresponds to the boron and carbon compounds with twofold and threefold coordination. (auth)

21954 THE EFFECT OF HALIDE IONS ON THE Hg ⇌ ^{203}Hg EXCHANGE REACTION BETWEEN AIR AND AQUEOUS SOLUTION. Magos, L. (Medical Research Council, Carshalton, Eng.). J. Chem. Soc. (A), No. 4, 545-6(1967).

The rate of exchange between metallic Hg vapour and aqueous $^{203}Hg^{II}$ solutions was determined in a dynamic system. It was found that the rate of exchange depends on the Hg^{II} concentration and the type and concentrations of the halides present in the solution. (auth)

21955 ISOTOPIC EXCHANGE REACTIONS AND RADIOCHEMICAL ANALYSES. Jordan, P. (Ecole Polytechnique Federale, Zurich). Chimia (Aarau), 21: 148-51(Apr. 13, 1967). (In French).

Isotopic exchanges form a special class of chemical reactions, which are distinguished from all the others by certain characteristics peculiar to them. Their study gives interesting information of a fundamental nature on the reactional behavior and the structure of the chemical elements involved in them. To know them and to take them into account is indispensable when applying techniques based on the use of radiotracers. They have found interesting analytical and preparatory applications in the field of the chemistry of isotopes. Various aspects of isotopic exchange reactions are illustrated by some characteristic examples taken from classical and recent scientific literature. (auth)

21956 NEW PHASE IN TELLURIDES OF RARE EARTH METALS OF THE CERIUM SUBGROUP. Eliseev, A. A.; Kuznetsov, V. G.; Yarembash, E. I.; Vigileva, E. S.; Antonova, L. I.; Zinchenko, K. A. (Inst. of General and Inorganic Chemistry, Moscow). Izv. Akad. Nauk SSSR, Neorg. Mater., 2: 2241-5 (Dec. 1966). (In Russian).

X-ray analysis was carried out on the $M_4Te_{7\pm x}$ compounds (M = La, Nd, Pr) and the structure and physical properties of these compounds studied. The electric conductivity and thermal emf of the $M_4Te_{7\pm x}$ are similar to those of semiconductors, with weak electric resistance (24.3 and 6.7×10^{-2} ohm · cm) and with large thermal emf (–100 and 125 μV/degree) for La_4Te_7 and Nd_4Tl_7, respectively. The crystallochemical similarity of the cerium subgroup tellurides suggests the possible existence of M_4Te_7 (or M_7Te_{12}) type phases for cerium and samarium. (R.V.J.)

21957 MECHANISMS OF ^{36}Cl AND ^{82}Br ISOTOPIC EXCHANGE OF $[Co(en)_2X_2]^+$ COMPLEXES. Roessler, K.; Schmidt, G. B. (Univ., Cologne). Z. Anorg. Allg. Chem., 349: 158-63 (Jan. 1967). (In German).

The isotopic exchange of Cl^- with trans-$[Co(en)_2Cl_2^+]^+$ and of Br^- with trans-$[Co(en)_2Br_2^+]^+$ in acid methanolic solutions and its dependence on temperature (30 to 60°C), complex salt, halide, and acid concentrations were investigated. For trans-$[Co(en)_2Cl_2^+]^+$ in 0.51N methanolic HCl a reaction velocity $k_1(40°C) = 0.53 \times 10^{-3}$ min^{-1} and an activation energy $E_A = 24$ kcal/mole were found, for trans-$[Co(en)_2Br_2^+]^+$ in 0.25N methanolic HBr k_1 (40°C) $= 3.9 \times 10^{-3}$ min^{-1} and $E_A = 20.0$ kcal/mole. From the experimental results the intermediate occurrence of a metastable solvate complex was concluded. The formation of ion pairs at increasing halide ion concentration accelerates the reaction. (auth)

21958 STUDIES OF SOLVENT CAPACITY OF ETHERS BY MEANS OF HYDROGEN ISOTOPIC EXCHANGE. IV. PHYSICOCHEMICAL PROPERTIES OF LITHIUM AND POTASSIUM TERT.-BUTYLATES IN DIMETHYL SULPHOXIDE AND HYDROCARBONS. Bessonov, V. A.; Alikhanov, P. P.; Gur'yanova, E. N.; Simonov, A. P.; Shapiro, I. O.; Yakovleva, E. A.; Shatenshtein, A. I. (Inst. of Physics and Chemistry, Moscow). Zh. Obshch. Khim., 37: 109-14(Jan. 1967). (In Russian).

Hydrogen isotopic exchange in ether solutions was studied and catalyst reactions with electron donors in the solution were determined by cryoscopic and ebullioscopic molecular-weight determination of alcoholates and by dielectrometric titration of the alcoholates of electron donors using solvents and by measuring the ir spectra and electric conductivity of the solutions. The lithium and potassium tert-butylates (BL and BK) associated in the solution; however, BL association was higher than BK. Variations in BL spectra dissolved in tetrahydrofuran and dimethyl sulfoxide differed from the spectra of BL solutions in hexane, diethyl ether, 1,2 dimethoxyethane, and 1,2 diethoxyethane indicating the change in the structure of BL associates in the first two solvents. Concentration of free ions in BL and BK ether solutions is negligible. The reactions of hydrogen isotopic exchange in ether solutions catalyze the associated alcoholate. (R.V.J.)

21959 STUDIES OF SOLVENT CAPACITY OF ETHERS BY MEANS OF HYDROGEN ISOTOPIC EXCHANGE. III. KINETICS OF DEUTERIUM AND TRITIUM EXCHANGE BETWEEN FLUORENE AND INDENE DURING THE CATALYSIS BY LITHIUM TERT.-BUTYLATE. Bessonov, V. A.; Yakovleva, E. A.; Yakushin, F. S.; Shatenshtein, A. I. (Inst. of Physics and Chemistry, Moscow). Zh. Obshch. Khim., 37: 101-8(Jan. 1967). (In Russian).

The rate of deuterium and tritium exchange between indene and fluorene in five ethers during lithium tert-butylate catalysis was studied to determine the relative solvent ability of ethers. A kinetics analysis was made of the reactions in tetrahydrofuran solutions. The conditions for the alcoholate participating in the catalytic reaction are discussed. (R.V.J.)

21960 KINETICS OF HOMOGENEOUS ISOTOPIC EXCHANGE BETWEEN METHYLENE IODIDE AND IODIDE IONS IN DIMETHYLFORMAMIDE. Elias, H. (Technische Hochschule, Darmstadt, Ger.). Radiochim. Acta, 6: 167-8(Dec. 1966). (In German).

The velocity and the temperature dependence of the isotopic exchange between ^{125}I-labeled methylene iodide and iodide ions in dimethylformamide were determined. The measurements were made in connection with the studies of the I isotope effects in the system $CH_2I_2-I^-$–dimethylformamide. The results indicate that the isotopic exchange between methylene iodide and iodide ions proceeds as a second-order reaction. An activation enthalpy of $\Delta H^{\ddagger} = 19.8$ kcal/Mol and an activation entropy of $\Delta S^{\ddagger} = -5.3$ cal/mol were found. The isotopic exchange proceeds much faster in dimethylformamide than in ethanol solvent. (J.S.R.)

21961 SPECTROSCOPIC STUDIES OF SENSITIZED LUMINESCENCE OF RARE EARTH IONS IN URANYL TETRACHLORIDE CRYSTALS. Krasilov, Yu. I.; Polyakov, Yu. A.; Rudnitskii, Yu. P. (Inst. of Radio Engineering and Electronics, Moscow). Izv. Akad. Nauk SSSR, Neorg. Mater., 2: 2186-98(Dec. 1966). (In Russian).

Sensitized luminescence of trivalent rare earth ions in uranyl tetrachlorides in the visible and close to the ir regions was studied at 300 and 77°K. The investigation revealed various types of activation centers. Detailed analysis was made of the individual properties of compounds activated by Pr^{3+}, Nd^{3+}, Sm^{3+}, Eu^{3+}, and Tm^{3+} in $Cs_2(UO_2Cl_4)$ polycrystals at 300 and 77°K. A considerable diminishing of the half-width of ion luminescence lines was observed with decreasing temperature. The half-lives of the excited states of the rare earth ions and of the uranyl ion were measured. The efficiency of rare earth ion sensitization was evaluated and the importance of energy migration along the lattice was stressed. (R.V.J.)

Radiation and Nuclear Chemistry

Refer also to abstracts 21855, 21918, and 22547.

21962 (AWRE-O-99/66) THE β RADIOLYSIS OF DICHLORODIFLUOROMETHANE. Jones, P. M. S.; Gibson, R.; Denny, P. J. (Atomic Weapons Research Establishment, Aldermaston (England)). Dec. 1966. 23p. Dep. mn. CFSTI $3.00 cy, $0.65 mn. HMSO 3s. 6d.

The availability of halogenated vacuum greases led to an interest in their interaction with tritium. To elucidate the products of radiolysis of this type of compound, the gas phase radiolysis of dichlorodifluoromethane was studied in the presence of tritium. The chief products were TCl and 1:4 dichlorooctafluorobutane with traces of CF_3ClT and $(CF_3Cl)_2$. G-values have been measured and a mechanism proposed for the radiolysis involving ion-molecule reactions: $G(-CF_2Cl_2) = 6.0 \pm 0.1$, $G(TCl) = 8.5 \pm 0.1$. (auth)

21963 (BNL-994, pp 3-19) CHEMISTRY. (Brookhaven National Lab., Upton, N. Y.).

Developments are reported for studies in: nuclear chemistry, which includes high energy nuclear reactions, nuclear spectroscopy, Brookhaven solar neutrino experiment, nuclear cosmochemistry and geochemistry, examination of art and archaeological objects by activation analysis; radiation chemistry; hot atom chemistry; molecular and crystal structure including magnetism, chemical crystallography, and Moessbauer spectra; isotope effects, including calculations of equilibrium and kinetic isotope effects, vapor pressures of isotopic species, equilibrium constant of the reaction $H_2O + D_2O \rightleftharpoons 2HDO$, kinetic isotope effects and organic reaction mechanisms; and physical chemistry, including inorganic reactions in solution, ion-molecule reactions, kinetics of hydrogen atom reactions, classical calculations on energy transfer, theoretical organic chemistry, and quantum theory. (P.C.H.)

21964 (BNL-11220) PURIFICATION OF MINE DRAINAGE WATER BY A RADIOLYTICALLY INDUCED CHAIN PROCESS. Steinberg, Meyer; Manowitz, Bernard (Brookhaven National Lab., Upton, N. Y.). Jan. 1967. Contract AT(30-2)-Gen-16. 11p. Dep. mn. CFSTI $3.00 cy, $0.65 mn.

Methods proposed for removal of Fe from waste water (in this case mine drainage water) usually consists of oxidation of the ferrous ion to ferric ion followed by hydrolysis to precipitate iron oxide. As an alternate scheme, and one that appears to have technical and economic promise, it is proposed to perform the oxidation and possible precipitation of Fe with high energy gamma radiation from isotopic sources, in the presence of an organic impurity and saturated air conditions. The organic material is oxidized to CO_2 and H_2O so that the organic pollutant is also removed in the process. Preliminary calculations indicate that as fast as the radiation treatment is concerned, the unit values fall well within the cost range of approximately $0.05 to $0.25/1000 gal. Either ^{60}Co or ^{137}Cs could be used as the radiation source. (P.C.H.)

21965 (COO-38-519) PROCEEDINGS OF THE FIFTH INFORMAL CONFERENCE ON THE RADIATION CHEMISTRY OF WATER [HELD AT NOTRE DAME, INDIANA], OCTOBER 24–26, 1966. Farhataziz; Knight, R. J.; Milner, D. J.; Mozumder, A.; Povinelli, R. J. (eds.) (Notre Dame Univ., Ind. Radiation Lab.). Contract AT(11-1)-38. 130p. (CONF-661045). Dep. mn. CFSTI $3.00 cy, $0.65 mn.

Thirteen articles are included along the lines of an informal discussion. Information is given on: primary yields; role of excited water; rate law and spatial distribution of ions; diffusion kinetics; search for spurs using pulse radiolysis; oxygenated species in acid solutions; oxygenated species in alkaline solutions;

intermediates; pressure effects; and radiation chemistry of water vapor. (P.C.H.)

21966 (COO-1385-20) ELECTRON SPIN RESONANCE STUDIES OF RADICALS IN IRRADIATED CRYSTALS. Rogers, Max T.; Kispert, L. D. (Michigan State Univ., East Lansing. Dept. of Chemistry). Mar. 21, 1967. Contract AT(11-1)-1385. 7p. (CONF-670114-1). Dep. mn. CFSTI $3.00 cy, $0.65 mn.

From International Conference on Spectroscopy, Bombay, India.

Free radicals induced in organic compounds by electron irradiation at 77 and 300°K were studied by ESR spectra. Sodium acetate trihydrate yielded the methyl radical at 77°K but only the CH_2COO^- radical at 300°K. Trifluoroacetamide gave rise to the trifluoromethyl radical at 77°K and to the CF_2CONH_2 radical at 300°K. Irradiated crystals of $CClF_2COONa \cdot 2H_2O$ gave only the radical CF_2COO^-, but these were in several different types of environment in the crystal lattice. The results indicate that aliphatic radicals of the type CXYZ are planar if one of the substituents is hydrogen and nonplanar if two or three of the substituents are fluorine. (P.C.H.)

21967 (IDO-16909) CHARACTERIZATION OF HIGH-BOILING PRODUCTS FROM IRRADIATED BIPHENYL AND TERPHENYLS. Solomon, P. W.; Hudson, P. S.; Moffat, A. J. (Phillips Petroleum Co., Bartlesville, Okla. Research and Development Dept.). Aug. 30, 1963. Contract AT(10-1)-1080. 47p. Dep. mn. CFSTI $3.00 cy, $0.65 mn.

Characterization work on the high-boiling components formed by pyrolysis and/or radiolysis of polyphenyls was performed. Distillation and solvent fractionation showed that considerable material above 200 molecular weight was present. High-boiler residue was more easily fractionated (solvent precipitation) than the parent coolant from which the residue was obtained. During radiolysis, weight average molecular weight changed more than number average and was more sensitive to higher-molecular-weight molecules. A sublimation/number average molecular weight method was developed for the determination of weight average molecular weight. Evidence for fused-ring structure, alkyl side groups, aliphatic unsaturation (possibly alkenyl groups), and polyphenyl structure was found. An organic, benzene-insoluble material was present in irradiated high-boiling products. The quantity of this material greatly increased by heating the high boiler in vacuo to 380°C. This insoluble material showed a structure similar to the total high-boiling products. However, chlorine became concentrated in the benzene insoluble fraction and the highest-molecular-weight soluble fractions. Before heating, the chlorine was distributed throughout all the fractions. A benzene solution of coolant or high boiler formed insoluble film on glass surfaces. The rate of film formation was studied in colorimeter tubes and high-molecular-weight fractions gave more film than low-molecular-weight fractions gave more film than low-molecular-weight fractions. Benzene insoluble sludge was centrifuged from benzene solutions of coolant or high boiler. Both film and sludge may be correlated with fouling tendencies in a reactor and serve as laboratory tests for coolant cleanliness. The susceptibility of the irradiated high-boiler products to oxidation was studied. A large amount of low-boiling acids was obtained, which indicated chain scission of high-molecular-weight polymers. Reaction of the high-boiling products with sulfuric acid, nitric acid, and bromine, and hydrogenation of the products contributed to the understanding of the structures present. (auth)

21968 (LFEN-63) RADIOLISE DE SOLUCOES DE ACIDO SULFURICO COM PARTICULAS α DE 5,3 MeV. I. SOLUCOES DILUIDAS. (Radiolysis of Sulfuric Acid Solutions by 5.3-MeV α Particles. I. Dilute Solutions). Mariano, M. Helena; Santos, M. Lima (Junta de Energia Nuclear, Sacavem (Portugal). Laboratorio de Fisica e Engenharia Nucleares). 1966. 18p. (In Portuguese). (CONF-660614-9). Dep. mn.

From 3rd International Congress on Radiation Research, Cortina, Italy.

Aerated sulfuric acid solutions in the concentration range from 5×10^{-3} to 1 M were irradiated with 5.3-MeV α rays. The curve, which represents the variation of the hydrogen peroxide yield with the acid concentration, presents a maximum, $G(H_2O_2) = 1.56$, for $(H_2SO_4) = 5.10^{-2}$ M. The results are interpreted on the basis of an interference of the acid in the phenomena taking place in the bulk of the solution and in the α track. The existence of reactions of the type, $SO_4^{=} + OH + H^+ \rightleftharpoons SO_4^{-} + H_2O$ is considered for this interpretation. (auth)

21969 (NYO-3718-1) DEVELOPMENT OF A RADIOACTIVE PEBBLE BED CHEMICAL REACTOR SYSTEM. Final Report: Phase I. Collins, C. H.; Cullinan, H. T.; Thomas, C. C. Jr.; Weller, S. (Western New York Nuclear Research Center, Inc., Buffalo). Sept. 15, 1966. Contract AT(30-1)-3718. 84p. Dep. mn. CFSTI $3.00 cy, $0.65 mn.

Background information was developed on potential source requirements and on the chemical reaction under consideration (the side chain chlorination of toluene to produce benzotrichloride); equipment was designed appropriate to a bench-scale investigation; and an economic evaluation was made of the proposed reaction. The chlorination of toluene can occur either by side chain substitution or by ring addition. Both the radiation-initiated and the photoinitiated chlorination reactions yield the same products under the same reaction conditions. Ring addition predominates at temperatures below 20°C while side chain substitution to produce benzotrichloride occurs essentially exclusively at temperatures greater than 80°C. The efficiency of energy utilization in the radiation chlorination of benzene has an inverse relationship to the LET of the incident radiation. The extent of the radiolysis of pure benzene (and toluene), an undesirable side effect, is directly related to the LET of the radiation. Beta sources, which would minimize adverse LET effects, are potentially available in several forms and configurations. Comparisons of the radiation chlorination of benzene with the photochlorination of benzene indicated that radioinduced chlorination is more efficient in energy utilization by an estimated factor of 6.5. Calculations of design parameters for a fluidized bed chemical reactor showed that particles of 250 μ or greater could be used in a small, bench-scale reactor, while particles of greater than 500 μ are indicated for best reactor performance in a commercial scale reactor. Estimates of the cost of producing benzotrichloride from toluene using a pebble bed radiation source are dependent on the G value for this reaction. Assumed G values ranging from 10^4 to 10^6 indicated that production costs for benzotrichloride are below or within the same range as comparable figures available from industry for the commercial photochemical process. (M.C.G.)

21970 (ORNL-4076, pp 117-39) OTHER ORNL PROGRAMS. (Oak Ridge National Lab., Tenn.).

Research progress is reported on: chemical support for the saline water program, effects of radiation on organic materials, and chemical support for the controlled thermonuclear program. (M.C.G.)

21971 (ORO-2945-7) PREPARATION OF WOOD-PLASTIC COMBINATIONS USING GAMMA RADIATION TO INDUCE POLYMERIZATION. Interim Report. Kent, James A.; Winston, Anthony; Boyle, William R.; Taylor, George B. (West Virginia Univ., Morgantown. Engineering Experiment Station). Mar. 17, 1967. Contract AT(40-1)-2945. 60p. Dep. mn. CFSTI $3.00 cy, $0.65 mn.

Several plastics for use in wood-plastic combinations (WPC) are recommended for further study. Special attention was given to the development of a rubberlike system to complement two hard plastics that are available. Chemicals were added to monomers and evaluated as to heat reduction during polymerization, reduction of radiation requirement, cost reduction of impregnant, improved physical properties, and imparting special properties to the WPC such as fire, insect, and chemical resistance. Data for the radiation polymerization of monomers, mixtures of monomers, and monomer additive systems in birch, loblolly pine, red oak, sugar maple, white pine, and yellow poplar are given. (F.S.)

21972 (UCRL-17299(Suppl.)) INDEX TO NUCLEAR CHEMISTRY DIVISION ANNUAL REPORT, 1966. (California Univ., Berkeley. Lawrence Radiation Lab.). Mar. 28, 1967. Contract W-7405-eng-48. 42p. Dep. mn. CFSTI $3.00 cy, $0.65 mn.

21973 (UJV-1739) MECHANISM OF THE HYDROGEN FORMATION IN THE RADIOLYSIS OF LOW TEMPERATURE METHANOLIC GLASSES. Teply, J.; Janovsky, I. (Ceskoslovenska Akademie Ved, Rez. Ustav Jaderneho Vyzkumu). [1967]. 31p. Dep. mn.

Studies showed that the hydrogen yield in the gamma radiolysis of glassy methanol at 77°K depends on many variables. In pure glass (always 5.8 mole % of water) the yield was 4.2 if the trapped electrons were bleached by light and 2.9 if the irradiated glass was rapidly thawed in dark. The presence of electron scavengers suppressed the hydrogen formation in both cases and discolored the glass; after the concentration was sufficient to cause total discoloration the hydrogen yield remained practically constant. The presence of hydrogen atom scavengers suppressed also the hydrogen formation at both photo- and thermal bleaching without causing complete discoloration after irradiation. From the results it has been concluded that the electrons freed from traps by light react with $CH_3OH_2^+$ ions giving hydrogen atoms with some excess of energy which enables them to abstract hydrogen atoms from methanol molecules. The yield of trapped electrons has been determined from the concentration dependencies to be 2.3. Simultaneously with the electrons the hydrogen atoms were independently formed during irradiation with the yield ~0.5 which were also able to abstract. The remaining hydrogen, i.e., ~1.4 was unscavengeable by the so-

lutes in the studied concentration range. It accompanied partly the formation of the CH_2OH radical (probably as hot hydrogen atoms with the yield ~1.1) and partly the formation of carbon monoxide and formaldehyde (most likely as molecular hydrogen with the yield ~0.3). (auth)

21974 ELECTRON SPIN RESONANCE OF RADICAL PAIRS IN X-IRRADIATED SINGLE CRYSTALS OF CLATHRATE COMPLEX OF HYDROQUINONE WITH ACETONITRILE. Ohigashi, Hiroji; Kurita, Yukio (Toyo Rayon Co., Ltd., Tebiro, Japan). Bull. Chem. Soc. Jap., 40: 704(Mar. 1967).

Phenoxy radical pairs trapped in X-irradiated crystals of clathrate complex of hydroquinone with acetonitrile were studied by ESR. The X-band ESR spectrum observed at 77°K consisted of three sets of doublets with unidentified lines at the center. The absorption of the radical pairs disappeared in 30 min at 190°K and the unidentified absorptions gave rise to new absorption spectra, which was attributed to a radical CH_2CN. Irradiated clathrate complexes of hydroquinone with SO_2, CO_2, HCl, and CH_3OH showed ESR spectra due to radicals pairs. (D.H.M.)

21975 METHODS FOR PRODUCTION OF CARRIER-FREE ^{52}Mn AND ^{54}Mn. Kukula, F.; Mudrova, B.; Krivanek, M. Isotopenpraxis, 3: 49-51(Feb. 1967). (In Russian).

Methods of ^{52}Mn and ^{54}Mn production are described. These methods are based on formation of water-insoluble manganese-thenoyltrifluoracetone chelate, which may be selectively extracted from the reaction media by means of ethylacetate. The simple and fast operation together with minimal losses of product appear to be the main advantages of the described separation processes. The yield of ^{52}Mn and ^{54}Mn was found to be higher than 90% per single extraction with TTA. (auth)

21976 PRIMARY PHOTOCHEMICAL REACTION IN IRRADIATION OF CONGEALED ETHANOL SOLUTIONS OF TRIPHENYLAMINE. Piskunov, A. K.; Verein, N. V.; Ozerova, G. A. (Scientific-Research Physical-Chemical Inst., Moscow). Zh. Fiz. Khim., 41: 940(Apr. 1967). (In Russian).

Studies on the EPR spectra of triphenylamine specimens γ-irradiated for 2 sec in C_2H_5OH and C_2H_5OD showed that the specimens have properties identical to those of γ-irradiated alcohols. The parameters of the EPR spectra were similar to those of the irradiated alcohols; like the alcohols the specimens became strongly saturated at 1 mV superhigh frequency, and were also sensitive to the visible light and rapidly recombined with the formed ethanol at room temperature. The intensity of EPR signals of stabilized electrons depended on the degree of congealed specimen crystallization. The maximum signals were found with transparent glass. (R.V.J.)

21977 PHOTOELECTRIC PROPERTIES OF GALLIUM ARSENIDE WITH RADIATIVE STRUCTURAL DISTURBANCES. Sevchenko, A. N.; Stel'makh, V. F.; Tkachev, V. D. (Belorussian State Univ., USSR). Dokl. Akad. Nauk BSSR, 10: 374-6(June 1966). (In Russian).

The relatively high impurity concentration and the lack of knowledge of the energy spectra of the residual impurity atoms makes it difficult to determine the energy spectrum and temperature stability of the currently available gallium arsenide crystals exposed to radiation. The problem is further complicated by the potential occurrence of different types of point damage. In view of the great sensitivity of the photoconductivity determinations, this method was was used for the investigation of the energy levels in the n and p type gallium arsenide single crystals exposed to fast neutron fluxes in the 10^{14} to 10^{17} n/cm^2 range. The spectral dependence of the photoconductivity was determined at 300 and 80°K with an instrument that allowed the measurement of resistivities up to 10^{12} ohm. It was found that the resistivity increases more markedly with hole-type materials. The radiation-damage spectrum was found to be quite complex: as many as 15 different centers were found in the n and p type materials. This may be due to the formation of a large number of associations between point defects and the residual chemical compounds. (TTT)

21978 STUDIES OF THE RADIOLYSIS OF SOME ROMANIAN PETROLEUM FRACTIONS IN THE I.F.A. NUCLEAR REACTOR. Stanoiu, Ileana I. (Inst. of Nuclear Physics, Bucharest); Mihaila, A. P.; Frangopol, P. T.; Balaban, A. T.; Popescu, B. A.; Oprescu, I.; Trusca, Viorica T. Rev. Roum. Phys., 11: 937-49(1966). (In French).

The behavior of several Romanian petroleum fractions (from different distillation fractions and specially purified) was studied after radiolysis in the nuclear reactor VVRS at high temperature. The yield of gas produced was used as a means for comparing the sensitivity of the fractions to radiolysis. For the high fractions radiolytic stability comparable to that of biphenyl was obtained which makes them of interest for use as coolants in nuclear reactors. (tr-auth)

21979 APPLICATION OF PYROLYTIC CHROMATOGRAPHY TO THE STUDY OF THE RADIOCHEMICAL POLYMERIZATION OF MIXTURES OF ISOPRENE WITH METHYL METHACRYLATE. Vacherot, Monique; Marchal, Jean; Hinschberger, Andre (Centre de Recherches sur les Macromolecules, Strasbourg). Compt. Rend., Ser. C, 264: 962-5(Mar. 13, 1967). (In French).

The radiochemical polymerization of the system isoprene–methyl methacrylate was carried out by gamma radiation, in the absence of oxygen, at 25 and −16°C. Analysis of the reaction products by pyrolytic chromatography permits proof of the coexistence of two mechanisms for the polymerization of irradiated isoprene, the one radical in nature and the other cationic. (tr-auth)

21980 EFFECT OF ENVIRONMENTAL HYDROGEN PRESSURE ON THE HYDROGEN YIELD FROM X-IRRADIATED POLYETHYLENES. Hill, Otto H.; Lightfoot, R. Pat (General Dynamics Corp., Ft. Worth, Tex.). J. Appl. Polymer Sci., 11: 515-26 (Apr. 1967).

Effects of hydrogen environmental pressure on the hydrogen yield from x-irradiated polyethylenes was studied. Contrary to observations of previous investigators, the hydrogen yield was found to be independent of hydrogen environmental pressures extending over the critical range up to at least 30 torr. It was demonstrated that neglecting the temperature and density gradients inherent in closed-volume irradiation assemblies employing cryogenic traps to separate liberated gases into condensable and noncondensable fractions may lead to erroneous conclusions with respect to gas yields arising from the irradiation of materials. A homogeneous, variable-plate separation ion chamber consisting of a polyethylene body and utilizing flowing ethylene as the cavity gas was employed to obtain total volatile G values of 3.6 ± 0.4, 3.8 ± 0.4, and 4.0 ± 0.4 molecules/100 eV, for Marlex 6002, Dow Ziegler (Q 917.5), and DuPont A-1410 polyethylenes, respectively. A hydrogen contribution of approximately 98 mole-% was obtained with this experimental method. (auth)

21981 STUDY OF TEMPERATURE PROCESS OF DECAY OF RADICALS FORMED IN RADIOLYSIS OF SOLID RUBBERS. Kozlov, V. T. Vysokomol. Soedin., 9: 515-21(Mar. 1967). (In Russian).

By means of ESR, temperature–time dependence of the decay of radicals formed during low-temperature gamma radiolysis (at −196°C) was studied. The radical decay started much below T_g on increasing amplitude of thermal vibrations and lower sterical hindrances existed in monomer units. For rubbers with side groups the contribution to the sudden rise of radical-decay rate above T_g was higher. The activation energy of radical-decay (E_T) was less than 1 kcal/mol below T_g and about 1 kcal/mol in the region of T_g thus comparable with activation energy of thermal motion at these temperatures. The values of molecular barriers (U_T) exceed E_T greatly. It is suggested that radical decay at low temperatures starts earlier as macromolecules move toward each other and the mechanism involves low activation-energy migration of secondary ions formed at capture of charges with free radicals. (auth)

21982 ELECTRON SPIN RESONANCE DETECTION OF RADICAL PAIRS FORMED BY GAMMA RADIOLYSIS OF CRYSTALLINE DIARYL CARBONATES. Davis, A. (Explosives R and D Establishment, Waltham Abbey, Eng.); Golden, J. H.; Mcrae, J. A.; Symons, M. C. R. Chem. Commun., No. 8, 398-9 (1967).

It was found that stable products of the radiolysis may include the corresponding o-hydroxydiphenyl ethers and CO. When phenyl-p-tolyl carbonate was irradiated only the mixed ether was formed, showing that the reaction is effectively intramolecular. This could be either a rearrangement, or due to a cage-effect subsequent to the process $(RO)_2CO \rightarrow CO + 2RO$. An ESR study of irradiated diaryl carbonate powders showed that this latter process does occur. The spectrum obtained from di-p-tolyl carbonate is reproduced, those from diphenyl and phenyl-p-tolyl carbonates were almost identical. The central feature is indication of a relatively small concentration of unpaired radicals. Features associated with a triplet state are also evident. A diagram is given showing the positions of the effective spin moments for cis- and trans-configurations of diphenyl carbonate. Cage recombination occurs before the radicals can diffuse through the crystal. (UK)

21983 MEASUREMENT OF THE X-RAY EFFECTS ON THE SYSTEMS IRON(II)/IRON(III) AND HEXACYANOFERRATE(II)/HEXACYANOFERRATE(III). Mohrmann, H.; Froben, F. W. (Univ., Goettingen, Ger.). pp 84-90 of Biophysikalische Probleme der Strahlenwirkung. Muth, H. Stuttgart, Georg Thieme Verlag, 1966. (In German).

A device was constructed which permitted continuous photometry under x-irradiation. Its operation was shown on the system Fe(II)/Fe(III) and then measurements were made on the hexacyanoferrate (II)/hexacyanoferrate(III) system. In the x-irradiation of the iron sulfate solutions the oxidation velocity of the ferrous ion was determined as a function of the depth for various x-ray doses. The hardest radiation caused the slowest change at the lower level while the softest radiation caused the most rapid change. The addition of methanol to the iron sulfate solution caused a faster oxidation than in the standard solutions. At higher doses the velocity decreases. The increase of the oxidation and the beginning of the reduction corresponds to the dose change with the depth. In the irradiation of hexacyanoferrate solutions the oxidation is not a zero order reaction at the beginning. In H_2SO_4 solution the initial reaction dominates. In NaOH solution the initial effect is weaker than in the neutral solution although it is still present. With the addition of methanol the effect of dissolved O_2 is evident. (J.S.R.)

21984 THE EFFECT OF ^{60}Co GAMMA RADIATION ON AQUEOUS FERRATE(VI) SOLUTIONS. Kalecinski, Jerzy (Inst. of Structural Research, Wroclaw). Rocz. Chem., 41: 195-200 (1967).

The kinetics of radiation reduction of ferrates(VI) was examined and the mechanism of this reaction was suggested. It was shown that the OH radicals are direct reducing agents in the ferrate reduction. Excited water molecules also reduce ferrates at concentration higher than 4.5×10^{-3} M. (auth)

21985 APPLICATION OF THE POTENTIOSTATIC METHOD IN STUDYING WATER RADIOLYSIS. Pangarov, N.; Raichevskii, G. (Inst. of Physical Chemistry, Bulgarian Academy of Sciences). Compt. Rend. Acad. Bulg. Sci., 20: 121-4(1967).

Products formed in the x radiolysis of water solutions of H_2SO_4 with small absorbed doses (of the order of 10^{17} eV/ml) in which the secondary reverse reactions between the radicals and the accumulated molecular products are negligible were investigated using the potentiostatic method. A linear dependence between the current strength and that of the dose was found, which is proof that all primary products have been investigated before any reverse reactions between the free radicals and the accumulated molecular products have taken place and thus complicate the problem. Thus the current strength is governed by the rate of formation of the radiolysis products. It was concluded that use of the potentiostatic method in studying radiolysis of water and water solutions allows a precise direct investigation of the kinetics of molecular products accumulation and the participation and properties of free radicals during irradiation. (P.C.H.)

21986 YIELD OF EXCITED WATER MOLECULES IN GAMMA RADIOLYSIS OF ACID NITROPRUSSIDE SOLUTIONS. Jezowska-Trzebiatowska, B.; Kalecinska, E.; Kalecinski, J. (Inst. of Structural Research, Wroclaw. Univ. of Wroclaw). Bull. Acad. Pol. Sci., Ser. Sci. Chim., 15: 77-81(1967).

The gamma-induced decomposition of sodium nitroprusside in acid solutions was studied. The kinetics and mechanism of nitroprusside decomposition was used to determine the yield of excited water molecules $G(H_2O^*)$. The nitrosylcyanide compounds of Fe, irradiated with gamma irradiation in aqueous solutions, were shown to undergo radiation decomposition, which results in the formation of Fe^{3+} ions and some other products according to the reaction: $Fe(CN)_5NO^{2-} \rightarrow Fe^{3+} + 5CN^- + NO$. The amount of Fe^{3+} ions formed in nitroprusside decomposition was a linear function of the dose. This fact and the low yield of nitroprusside decomposition, related to the concentration, suggest that it was not the radical reactions that determined the process. It is highly probable that the water molecules, excited by radiation, transfer their energy to the nitroprusside ions, which then decompose. The yield of excited water molecules obtained from experimental data was in good agreement with previous estimates. (D.H.M.)

21987 SOLID PHASE RADIOPROTECTION IN MOLECULES WITH π ELECTRONS. Van de Vorst, A.; Richir, M. Bull. Cl. Sci., Acad. Roy. Belg. (5), 52: 969-77(1966). (In French)

Paramagnetic resonance was used to determine the free radical yield in substances of biological interest characterized by the presence of π electrons. The predominant effect of the aromatic constituent on the importance and the localization of the radicals induced by the radiation was arrived at by the analysis of the G-values together with the examination of the form of the spectra. (tr-auth)

21988 PREPARATION AND APPLICATION OF THE RADIONUCLIDE ^{130}I. Duftschmid, K. E.; Sorantin, H. (Oesterreichische Gesellschaft fuer Atomenergie GmbH, Seibersdorf, Austria). Monatsh. Chem., 97: 1332-8(1966). (In German).

Determination of ^{130}I by γ spectrometry is best achieved by integral measurement with a discriminator wave at 0.2 MeV. Separation from ^{131}I is achieved by use of a discriminator wave of 0.8 MeV for measurement of the ^{130}I line at 1.15 MeV. The preparative procedure uses a sample from natural U irradiated 3900 Mw-days and stored 1½ years. The sample is dissolved in HNO_3 and the ^{127}I and ^{129}I absorbed in alkaline bisulfite solution. This was acidified and the SO_2 driven off. Iodide was then oxidized to I_2 with H_2O_2 and extracted with CCl_4; the organic phase was treated with SO_2 and the iodide extracted with water. This cycle was repeated 3 times. The final aqueous solution was boiled to remove SO_2 and the solution made weakly ammoniacal and evaporated; the residue was dissolved in 0.1N NH_3 and evaporated in a quartz capsule, which was placed in the reactor. After decay of ^{128}I, the spectrum of ^{130}I was obtained contaminated with ^{64}Cu. The latter was removed by two cycles of the type given earlier. A small amount of activity (1%) is due to ^{126}I. Irradiation for 25 hours with 10^{13}n/cm^{2}sec produces 8 mCi ^{130}I/mg(^{127}I + ^{129}I) of 99% purity. (BBB)

21989 KINETICS OF THE SOLID-STATE POLYMERIZATION OF N-VINYLCARBAZOLE. Tuedos, Ferenz; Boros-Gyevi, Edit (Central Inst. of Chemical Research, Budapest). Magyar Kem. Foly., 73: 60-8(Feb. 1967). (In Hungarian).

The polymerization of N-vinylcarbazole, initiated by γ radiation, was examined. The process was found to be autocatalytic whose rate may be described by the expression $dx/dt = K\text{It}\, x^{1,2}(1-x)^2$ where $x = \xi/\xi_\infty$, and ξ is the conversion. The degree of polymerization changes according to a maximum curve and depends on the conversion as represented by the following equation: $\bar{P}(x) = P_0 x^\beta \times (1-x)$ where $\beta = 0.2 \pm 0.1$. Thus the expression for the rate of initiation is: $W_i = (K\text{It}/P_0)[x(1-x)]$. The elementary processes of the polymerization are discussed in detail. Initiation and chain growth take place at the interface between the polymer and monomer, while the chain termination process is probably to be interpreted by the "burial" mechanism. According to experiments made with chemical initiation, the kinetics of polymerization and the change of the degree of polymerization agree in the main lines with those found for radioinduced initiation. From this result it may be concluded that N-vinylcarbazole polymerizes by a radical mechanism in the solid state. (auth)

21990 INVESTIGATIONS IN THE FIELD OF RADIATION-INDUCED SOLID-STATE POLYMERIZATION. XX. THE CHARACTERISTICS OF SOLID STATE POLYMERIZATION OF N-VINYLSUCCINIMIDE. Hardy, Gyula; Varga, Jozsef; Nagy, Gabor; Cser, Ferenc; Eroe, Janosne. Magyar Kem. Foly., 73: 55-9(Feb. 1967). (In Hungarian).

The physical and chemical structure of the polymers obtained by the solid state polymerization of N-vinylsuccinimide was identical with that of the polymers formed in the liquid state. It may be established on the basis of the character of obtained polymers, ESR investigations, and from our earlier kinetical measurements that N-vinylsuccinimide belongs to the group of monomers not polymerizable in the crystal lattice. A kinetic equation, derived with considerations of radical accumulation and of the influence of the amorphous polymeric phase, was derived to describe the accelerating kinetics of the solid state polymerization of monomers non-polymerizable in crystal lattice. (auth)

21991 THE REACTION OF ACETYLENE WITH γ RADIATION UNDER PRESSURE. II. Yashiro, Dairokuro; Naito, Teruyuki. Tokyo Kogyo Shikensho Hokoku, 62: 91-5(Mar. 1967). (In Japanese).

Acetylene was polymerized by irradiation with γ rays from ^{60}Co under pressure in the range from 3.5 to 16 atm (absolute) and in the temperature range from 30 to 100°C. The value of $G(-C_2H_2)$ for the over-all reaction was nearly constant in this range, (≈80), but $G(C_6H_6)$ decreased from 15 to 6 with increasing acetylene pressure, and $G(-C_2H_2)$ for polymer formation increased from 25 to 60 with increasing pressure. The apparent activation energies for both reactions were very small, and the rates were proportional to the 0.8th order of dose rate. $G(C_6H_6)$ was not influenced by variation of surface–volume ratio of reaction vessel. G(diacetylene) was less than 1 and approximately proportional to $G(C_6H_6)$ in this range. (auth)

21992 EFFECT OF IONIZING RADIATION ON SOME THERMOLABILE COMPOUNDS. I. BEHAVIOUR OF PHENYLETHYLBARBITURIC ACID AND ITS SODIUM SALT UNDER EFFECT OF γ ^{60}Co RADIATION. Bednarczyk, Wladyslaw; Bukouwska, Hanna (Inst. of Pharmaceuticals, Warsaw). Przem. Chem., 45: 566-9 (Oct. 1966). (In Polish).

In studies on the usefulness of ionizing radiation in sterilization of thermolabile pharmaceuticals, phenylethylbarbituric acid and its sodium salt, in the form of a solid and an aqueous solution, were submitted to 2×10^6 RAD of gamma ^{60}Co radiation. The stability of the compounds examined was established by observation of the exterior of samples, their solubility, melting point determination,

and studies of their infrared and ultraviolet absorption spectra. (auth)

21993 RADIATION INITIATED ADDITION REACTIONS. VI. ADDITION OF BENZENETHIOL ON OLEFINS. Rabilloud, Guy (CEN, Grenoble, France). Bull. Soc. Chim. France, No. 2, 384-7(Feb. 1967). (In French).

The radiochemical initiation of the addition of benzenethiol on the double bond of aliphatic and alicyclic olefins is a way of synthesizing arylaliphatic sulfides. The reactions proceed by a radical chain mechanism leading to an "abnormal" addition product in high yield, but with olefins having an internal double bond, there is a formation of two isomeric sulfides depending whether the phenylthiyle radical fixes on either one or the other unsaturated carbon atoms. The efficiency of γ rays as initiating agent calculated on the basis of the total radiochemical yield varies between 50 and 100. (auth)

21994 RADIATION CHEMISTRY OF POLYETHYLENE. IX. TEMPERATURE COEFFICIENT OF CROSS-LINKING AND OTHER EFFECTS. Kang, H. Y.; Saito, O.; Dole, M. (Northwestern Univ., Evanston, Ill.). J. Amer. Chem. Soc., 89: 1980-6(Apr. 26, 1967). (COO-1088-23).

A study was made of the temperature coefficient over the range 35 to 120°C of chemical processes that occurred during the γ irradiation of polyethylene: hydrogen evolution, formation of crosslinks, chain scission, vinylene double-bond and conjugated-diene formation, and vinyl decay. To calculate crosslinks from gel–dose data, use was made of the Charlesby–Pinner function as modified for a Wesslau molecular-weight distribution. Good agreement of the data with the resulting equations was obtained in the case of the initial slope and general shape of the $s + s^{1/2}$ vs dose curve. Deviations at high doses are shown quantitatively to be related to vinylene decay; thus for the first time definite evidence of change of G(X) with dose was obtained. G(X) at zero dose is almost independent of temperature, but at the highest dose studied, 27 Mrads, G(X) increased significantly with temperature. Hydrogen yields increased slightly with temperature, but at the highest temperature, 120°C, $G(H_2)$ was practically independent of dose. Material balance was realized to ±0.2 G unit at 35 and to ±0.1 at 120°C both at zero and 27-MRAD dose. However, to obtain material balance, it was necessary to consider diene G values and their variation with dose. G values for both diene and vinylene unsaturation were independent of temperature. It is shown that conflicting results of earlier workers are due to failure to extract completely the soluble fraction of the irradiated sample and to oxidative chain degradation occurring subsequent to the irradiation because of the presence on exposure to air of unreacted free radicals. (auth)

21995 HETERONUCLEAR DOUBLE RESONANCE: ^{119}Sn–^{13}C SPIN–SPIN COUPLING IN ORGANOTIN COMPOUNDS. McFarlane, W. (National Physical Lab., Teddington, Eng.). J. Chem. Soc. (A), No. 4, 528-30(1967).

The nuclear magnetic resonance spectra of a series of methyltin halides containing ^{13}C, ^{117}Sn, and ^{119}Sn in natural abundance were measured. In all cases the reduced coupling constant $K(^{119}Sn-^{13}C)$ was positive, and $K(^{119}Sn-^{1}H)$ negative. There was an approximately linear correlation between $J(^{119}Sn-^{13}C)$ and $J(^{119}Sn-^{1}H)$, but the form of the relation indicates that terms other than the Fermi contact interaction must make an appreciable contribution to at least one of the two coupling constants. (auth)

21996 DENSITY-DOSE BEHAVIOR OF IRRADIATED POLYTETRAFLUOROETHYLENE. Scherer, A. E.; Kline, D. E. (Pennsylvania State Univ., University Park). J. Appl. Polymer Sci., 11: 341-55(Mar. 1967).

The nature of the room temperature density–dose relations in polytetrafluoroethylene (PTFE) were studied over the dose range of 10^4 to 10^9 RAD. Under various conditions, samples of PTFE were irradiated in combinations of neutron and gamma (reactor and ^{60}Co) radiation fields resulting in density increases up to approximately 5%. For the dose range 10^5 to 10^8 RAD, the increase in density measured at 0°C was approximately proportional to the logarithm of the radiation dose. For doses less than about 10^5 RAD, the increase in density appeared to be directly proportional to the dose, while above 10^8 RAD the density reached a maximum and then began to decrease. By examining the changes in slope and displacement of the curves which occur under various conditions, several effects are discernible. Compared to the effects of γ rays alone, the density increase per dose in the 10^5 to 10^8 RAD region is lower for cases where both neutrons and γ rays are present in the radiation field. This may suggest that competing processes are involved in producing density changes. The discernible difference between effects of γ radiation and reactor radiation appears to be unique in polymers. The ambient temperature during irradiation and the post-irradiation heat treatment of the specimens affect the changes in density. For dose rates over the range 0.1×10^6 to 13×10^6 RAD/hr, no dose rate effects were observed. The feasibility of using PTFE for some types of radiation dosimetry was demonstrated, and its possible usefulness is being investigated. (auth)

21997 CHEMICAL EFFECTS OF NUCLEAR TRANSFORMATIONS IN SOLIDS. Mueller, Horst (Univ., Freiburg i. B.). Angew. Chem. Int. Ed. Engl., 6: 133-49(Feb. 1967).

The chemical effects of nuclear transformations in solids are reviewed. Topics treated are nuclear recoil, influence of charge, retention, annealing, models of recoil chemistry including the disorder model, high-energy atoms in solids, and the Mössbauer effect. (209 references). (J.G.B.)

21998 CHARGE TRANSFER IN BINARY ORGANIC LIQUID MIXTURES OF CYCLOHEXANE AND METHYL-SUBSTITUTED BENZENES. Horikiri, Shozo; Saigusa, Toshifumi; Morita, Kazutoshi (Sumitomo Atomic Energy Ind., Ltd., Takarazuka, Japan). Bull. Inst. Chem. Res., Kyoto Univ., 45: 69-76(Jan. 1967).

Radioinduced light emission from binary liquid mixtures of cyclohexane and various methyl-substituted benzenes was measured. Kinetic equations of the Stern–Volmer type cannot explain the variation of emission intensities from each component. The kinetic equation derived under the assumption that energy transfer is possible only within the region of influence around excited cyclohexane gives a satisfactory explanation of the variation. The results obtained suggest that the energy transfer between cyclohexane and methyl-substituted benzene is considered to be due to a charge-transfer mechanism, and give the charge-transfer distances and the lifetimes of the charge-transfer pairs. (auth)

21999 CHEMICAL MODIFICATION OF FIBERS BY THE GRAFT COPOLYMERIZATION OF REACTIVE MONOMERS. I. GRAFT COPOLYMERIZATION OF ACRYLAMIDE AND GLYCIDYL METHACRYLATE ONTO COTTON FABRIC AND CROSSLINKING OF THE GRAFT COPOLYMERS. Tsuji, Waichiro; Ikeda, Tetsuo; Umatani, Mikiko; Kadono, Yoriko (Kyoto Univ.). Bull. Inst. Chem. Res., Kyoto Univ., 45: 77-86(Jan. 1967).

Reactive monomers such as acrylamide and glycidyl methacrylate were graft copolymerized on cotton fabric by ^{60}Co γ-irradiation. Crosslinking was then introduced to these grafted cottons by use of the reactive side groups. The crease recovery and some tensile properties of the grafted and crosslinked cotton were examined. With appropriate crosslinking, dry and wet crease recoveries of the grafted cotton were improved for either acrylamide or glycidyl methacrylate. Though the tensile strength of the grafted cotton fabric was decreased by crosslinking, the tensile damage of cotton resulting from crosslinking was remarkably decreased by the the grafting. (auth)

22000 CHEMICAL MODIFICATION OF FIBERS BY THE GRAFT COPOLYMERIZATION OF REACTIVE MONOMERS. II. GRAFT COPOLYMERIZATION OF ACRYLIC ACID ONTO POLYPROPYLENE AND POLYVINYL CHLORIDE FIBERS. Tsuji, Waichiro; Ikeda, Tetsuo; Kuorkawa, Yoko (Kyoto Univ.). Bull. Inst. Chem. Res., Kyoto Univ., 45: 87-96(Jan. 1967).

Some properties of polypropylene and polyvinyl chloride fibers grafted with acrylic acid using ^{60}Co γ-irradiation were examined. Though the tensile properties of grafted and aftertreated fibers were nearly equal to the original fiber, heat shrinkage of the fibers was remarkably decreased by acrylic acid grafting and aftertreatment with inorganic metal salts. Tensile properties at elevated temperatures were not improved as much as expected from the decrease of heat shrinkability. By acrylic acid grafting and Na salt aftertreatment, moisture regain increased and frictional electricity decreased, while wet tensile strength, heat settability, and dimensional stability in wet state were almost unchanged. (auth)

22001 DIELECTRIC PROPERTIES OF GAMMA-IRRADIATED TETRAFLUOROETHYLENE–HEXAFLUOROPROPYLENE COPOLYMERS. Koizumi, Naokazu; Yano, Shinichi; Tsuji, Fukuju; Nakamura, Naotake; Kobayashi, Shigeo (Kyoto Univ.). Bull. Inst. Chem. Res., Kyoto Univ., 45: 97-104(Jan. 1967).

The effect of gamma-irradiation on dielectric properties in copolymers of tetrafluoroethylene and hexafluoropropylene (TFE-HFP copolymer) was investigated in connection with possible change in the structure of this copolymer. The dielectric constant and loss were measured on irradiated TFE-HFP copolymers with different irradiation doses at frequencies from 1 to 300 kHz over a temperature range from –40 to +180°C. In accordance with the dielectric constant versus temperature relation the coefficient of thermal expansion in the copolymers exhibited a small change at about 60°C, indicating the existence

of a transition. The changes in both the dielectric constant and the expansion coefficient were obscured for a highly irradiated copolymer. The sizes of the α and γ relaxations found for unirradiated copolymers were influenced by gamma irradiation. On increasing the irradiation dose the magnitude of the γ loss peak increased and the α loss peak showed a considerable change at the dose of 10MR. The γ relaxation was also dependent on the degree of crystallinity. The activation enthalpy and entropy for the α relaxation were reduced by increasing the irradiation dose, while these activation parameters in the γ one showed a gradual increase. The results are discussed in relation to the chain scission of the copolymer by gamma-irradiation. (auth)

22002 RADIATION-INDUCED GRAFT COPOLYMERIZATION OF METHYL METHACRYLATE ONTO POLY(VINYL ALCOHOL) FILM IN THE PRESENCE OF CHAIN TRANSFER AGENTS. Sakurada, Ichiro; Ikada, Yoshito; Yamaoka, Takashi (Kyoto Univ.). Bull. Inst. Chem. Res., Kyoto Univ., 45: 1-11(Jan. 1967).

The grafting of methyl methacrylate onto poly(vinyl alcohol) by pre-irradiation techniques was studied in the presence of various chain transfer agents such as n-butyl mercaptan, triethylamine, and trichloroethylene. It was found that the length of grafted side-chain could be reduced by the use of these chain transfer agents. Chain transfer constants estimated from the change in degree of polymerization of homoPMMA formed during the grafting and PMMA obtained by the usual catalytic polymerization were in good agreement. Not only percent grafting and graft efficiency, but also overall rate of polymerization were decreased with increasing concentration of chain transfer agents. From the results it was concluded that the growing radicals on the grafted side-chain were transferred to the chain transfer agent and, that the radicals derived from chain transfer agent partially deactivated the active species for grafting besides re-initiation of the homopolymerization. The grafting was also carried out in the presence of p-benzoquinone, which is known as a retarder, and some discussion was given on the result obtained. (auth)

22003 ELECTRON SPIN RESONANCE STUDY OF RADIATION- AND FREE RADICAL-INDUCED REACTIONS OF METHYLENECYCLOALKANES. Takeda, Keiji; Yoshida, Hiroshi; Hayashi, Koichiro; Okamura, Seizo (Kyoto Univ.). Bull. Inst. Chem. Res., Kyoto Univ., 45: 55-62(Jan. 1967).

Methylenecycloalkane free radicals were studied by electron spin resonance methods at −196°C. Free radicals are formed in four ways: electron-irradiation, ultraviolet-irradiation, reaction with methyl radicals, and reaction with hydroxy radicals. The observed electron spin resonance spectra are assigned and the mechanism of free radical formation reactions discussed. For methylenecyclopropane and methylenecyclobutane, the alkane ring opening reaction plays an important role, whereas the methylenecyclopentane radical is formed only through abstraction of the hydrogen atom from the alkane ring. The four methods of radical formation are divided into two groups, each of which brings about the different types of free radicals. (auth)

22004 EPR AND OPTICAL STUDIES ON γ-RAY IRRADIATED $CdCl_2$:Ag AND $MgCl_2$:Ag. Matsumoto, Hiroaki; Miyanaga, Takeshi (Kyoto Univ.). Bull. Inst. Chem. Res., Kyoto Univ., 45: 43-54(Jan. 1967).

Isothermal decay processes of two paramagnetic centers and one optical absorption band in γ-irradiated $CdCl_2$:Ag were investigated. Decay kinetics of these centers were observed as first order in the initial stage and second order in the latter stage. Activation energies of two paramagnetic centers, A and B, are 0.76 and 0.71 eV, respectively, for first order kinetics. Of the three optical absorption bands 397, 515, and 1000 mμ, the 397 mμ band is most sensitive to thermal treatments and its activation energy was observed to be 0.60 eV for first order kinetics and this band may correspond to either A or B center. EPR and optical absorption spectra of γ-irradiated $MgCl_2$:Ag are also reported. A single C line at g = 2.034, a broad band for Ag^{2+} at g = 2.067, and a pair of hyperfine lines for Ag^0 with $A/g\beta$ = 1226 G at g = 2.005 were found in the EPR spectrum. The optical absorption spectrum is very similar to that of $CdCl_2$:Ag. After consideration about thermal properties and correspondence of spectra of $CdCl_2$:Ag and $MgCl_2$:Ag, it is proposed that models for B and C centers are tetrahedrally arranged aggregates of Cd^{2+} ions with an unpaired electron and similar aggregates of Mg^{2+} ions with an unpaired hole, respectively. (auth)

22005 PHOTOCHEMISTRY OF THE SYSTEM UO_2^{2+}–H_2O_2. Havemann, R.; Schiller, K.; Schneider, W. (Arbeitstelle fuer Photochemie, Berlin). Z. Phys. Chem. (Leipzig), 233: 343-52(1966). (In German).

The photolysis of H_2O_2 with UO_2^{2+} ions in 2N H_2SO_4 proceeds through a spongy deposition compound between H_2O_2 and UO_2^{2+} in the ratio 1:1. The spectrum is not changed through the complex formation. The quantum yield has the value $\phi = 1$ with respect to the complex. Assumptions were made as to the condition under which this reaction could be used for actinometric measurements. Orienting measurements on alkaline and soda alkaline solutions showed that these are unsuitable for actinometric measurements. (tr-auth)

22006 STANDARDS OF MEASUREMENT. Terrien, J. (International Bureau of Weights and Measures, Sevres, France). Vienna, International Atomic Energy Agency, 1966, Preprint No. SM-79/1, 12p. (In French). (CONF-661012-45). DTIE.

From IAEA Symposium on the Standardization of Radionuclides, Vienna.

A number of aspects which are characteristic of the standards of measurement for the main physical quantities are considered. This is followed by a discussion of the role of the International Bureau of Weights and Measures in establishing standards for radionuclides. (S.F.L.)

Radiochemistry

Refer also to abstracts 23478 and 23710.

22007 (AERE-R-5130) THE MEASUREMENT OF W, THE AVERAGE ENERGY TO PRODUCE AN ION PAIR, FOR RECOIL NUCLEI IN CARBON DIOXIDE. Leake, J. W. (Atomic Energy Research Establishment, Harwell (England)). Jan. 1967. 30p. Dep. mn. CFSTI $3.00 cy, $0.65 mn. HMSO 4s.

Preliminary measurements of W, the average energy required to create one ion pair in a gas, are presented for carbon and oxygen recoil nuclei produced by the elastic scattering of neutrons in carbon dioxide gas. The observations cover a range of recoil energies, from 100 keV to 2.9 MeV, for which there are no published data. The accuracy of the measurements is not high; the results are thought to be 10 to 20% higher than the true values because of the effects of columnar recombination. Three semi-theoretical expressions relating the value of W to the energy (or velocity) of the ionizing particles are discussed and compared with the published experimental data for argon and the present results for carbon dioxide. (auth)

22008 YIELDS OF RADIOACTIVITIES INDUCED BY (γ,n) REACTIONS WITH 20-MeV BREMSSTRAHLUNG. Oka, Yoshinaga; Kato, Toyoaki, Nomura, Koichi, Saito, Tatsuya (Tohoku Univ., Sendai). Bull. Chem. Soc. Jap., 40: 575-9(Mar. 1967).

The yields of radioactivities resulting from the (γ,n) reactions on 37 elements covering the periodic table were determined by means of 20-MeV linear accelerator bremsstrahlung and gamma spectrometry. The yield values, as measured in the number of photodisintegrations per mole per roentgen for each of the (γ,n) reactions, increase in the main regularly with atomic number from 10^3 through 10^7 order of magnitude. Anomalously small yield values are obtained in the irradiation of the nuclides with neutron or proton number of the magic numbers. The present results permit studies of general behavior of the photoneutron reactions and of the application of their products to the photoactivation analyses of many elements distributed throughout the periodic table. (auth)

22009 FURTHER INVESTIGATIONS ON THE ISOMERIC EFFECT IN SZILARD-CHALMERS RECOIL OF ^{60m}Co AND ^{60g}Co IN RELATION TO THE CHEMICAL CONSTITUTION OF THE TARGET. Lazzarini, E.; Fantola-Lazzarini, A. L. (Politecnico, Milan). J. Inorg. Nucl. Chem., 29: 895-902(Apr. 1967).

The influence of cis–trans isomerism and of the rest of the crystal structure, outside the first co-ordination sphere, on the isomeric effect in the Szilard–Chalmers recoil of ^{60m}Co and ^{60g}Co in Co(III) complexes were investigated. Four pairs of cis–trans isomers, four salts of $[Co\ en_2\ CO_3]^+$, and eight salts of $[Co\ en_3]^{3+}$ were examined. It was found that both factors had only a second order influence on the isomeric effect in the Szilard–Chalmers recoil, which was chiefly dependent on the immediate surroundings of the cobalt atom. Possible mechanisms leading to the isomeric effect are discussed. (auth)

22010 POSITRONIUM: ITS FORMATION, COMPOUNDS, AND SIGNIFICANCE IN RADIATION CHEMISTRY. Spurny, Zdenek (Inst. for Nuclear Research, Prague). Chem. Listy, 61: 141-8(Feb. 1967). (In Czech).

A literature review (17 references, 70% in English on positronium (Ps) is presented. Positronium was suggested in 1930 and demonstrated in 1932. The best laboratory source is ^{22}Na, which emits a 0.54-MeV positron in decaying, with a half-life of 2.3 years, to ^{22}Ne. The ^{22}Ne is formed in the excited state and de-excited, in 10^{-11} second, by emitting a 1.28-MeV photon. Irradiation of matter by hard gammas is discussed. Matter in all three states, gas, liquid, or solid, may be irradiated with positronium. Reactions of positronium with gaseous materials, especially oxy-

gen in which the reaction $Ps + O_2 \rightarrow PsO_2$ occurs, are discussed. Positronium reduces the NO_3^- radical to $NO_3^=$, forming PsO in the process. Reactions in the solid phase, where the thermalized period of positronium is very short, e.g., 10^{-10} second in gold, are also discussed. (TTT)

22011 USE OF COMPUTERS FOR RADIOCHEMICAL ANALYSIS. Muenzel, H. (Kernforschungszentrum, Karlsruhe, Ger.). Chimia (Aarau), 21: 125-9(Mar. 15, 1967). (In German).

The usefulness of the application of radiochemical methods in analytical chemistry depends quite often on the ability to determine the activity of the single components in a mixture of radionuclides. One way to solve this problem is to analyze the gamma spectra or the decay curve of the sample. The graphical methods normally applied for this evaluation of the data show some drawbacks, which could be avoided by using numerical methods. But numerical analysis of the measured data is so elaborate that electronic computers must be used. It is now possible to calculate the γ-energy, and relative intensity or half-lives, and the activity of the components by a least square fit. In addition to the very good accuracy of the results and the high speed of the analysis, the use of the computer for the evaluation of the measured data turns out to be rather economical. Depending on the problem the price per analysis amounts to $0.50 to $40.00. (auth)

Separation Processes

Refer also to abstracts 21855, 21858, 21869, 21872–21874, 21876, 21918, 21952, 21964, 23611, and 23654.

22012 (K-L-1780(Pt.18)) ORGDP FUEL REPROCESSING STUDIES. Progress Report for Period Ending December 31, 1966. Smiley, S. H. (Oak Ridge Gaseous Diffusion Plant, Tenn.). Feb. 10, 1967. Contract W-7405-eng-26. 22p. Dep. mn. CFSTI $3.00 cy, $0.65 mn.

Developments are reported for studies on: oxidation step in the semiworks reactor facility; fluidization tests for possible application in separating U_3O_8 fines for the bed of the main reactor by elutriation; performance testing of filters in volatility process corrosive atmospheres, corrosion of materials of construction; operation of the ORGDP peripheral compressor in fluorine recirculation service, evaluation of a possible solids shut-off valve; and testing of a temperature-compensated connector. (P.C.H.)

22013 (NUMEC-3292-1) THE PURIFICATION OF BF_3-DIMETHYL ETHER COMPLEX FEED THROUGH THE USE OF AN ACTIVATED CHARCOAL COLUMN. Williams, Weldon F.; Shuster, E. R. (Nuclear Materials and Equipment Corp., Lewiston, N. Y. Niagara Div.). Dec. 1, 1966. Contract AT(40-1)-3292. 20p. Dep. mn. CFSTI $3.00 cy, $0.65 mn.

A method is described for the partial removal of decomposition products and impurities in BF_3-dimethyl ether complex. Color is removed and decomposition products (primarily methyl borate) are decreased by passing the complex through an activated charcoal column. The determination of adsorption isotherms for various charcoals showed a great difference in performance from brand to brand. A small quantity of extremely good purity was produced followed by a considerably larger withdrawal of products showing some improvement, but indicating the rapid establishment of an equilibrium between the feed and impurities. (auth)

22014 (RT-ING-(66)18) PROGRESS ON THE PCUT PROGRAM. Orsenigo, G.; Cambi, S. (Comitato Nazionale per l'Energia Nucleare, Rome (Italy)). 1966. 30p. Dep. mn.

The technical and financial status of the PCUT program is described and the construction costs of the reprocessing and fuel fabrication plant are analyzed. The future activity of the plant, after the Elk River reactor fuel campaign, is being investigated by means of assessment studies and research and development work, which cover the possible application of the thorium–uranium cycle to the light water (PWR or BWR) reactors, heavy water moderated reactors, and HTGCRs. (auth)

22015 EFFECT OF DILUENT UPON EQUILIBRIUM FOR THE SYSTEM: $NdCl_3$-HCl-H_2O-1 M DI(2-ETHYLHEXYL) PHOSPHORIC ACID. Corless, J.; Lenz, T.; Smutz, M. (Ames Lab., Iowa). Contract W-7405-eng-42. J. Inorg. Nucl. Chem., 29: 1171-3(Apr. 1967). (IS-1247).

Comparison was made of carbon tetrachloride, cyclohexane, benzene, and toluene as bis(2-ethylhexyl)ester of phosphoric acid (D2EHPA) diluents for the extraction of Nd from chloride media at higher than tracer metal concentrations. Results were qualitatively consistent with other published data for similar systems at tracer concentrations. (UK)

22016 DILUENT EFFECTS IN THE EXTRACTION OF SELECTED METALLIC CATIONS BY BIS(HEXOXY-ETHYL) PHOSPHORIC ACID. Mason, G. W.; Bollmeier, A. F.; Peppard, D. G. (Argonne National Lab., Ill.). J. Inorg. Nucl. Chem., 29: 1103-12(Apr. 1967).

The extraction of Ca^{2+}, UO_2^{2+}, Am^{3+}, Eu^{3+}, and Tm^{3+} from aqueous chloride phases into solutions of $(n\text{-}C_6H_{13}OCH_2CH_2O)_2PO(OH)$, symbolized as HDHoEP, in four different diluents was studied as a function of concentration of extractant in the organic phase and of hydrogen ion in the aqueous phase. The distribution ratio, K, for each cation in each system was converted to a derived quantity, K_S, by means of the following defining equation, at 1.0 F(HCl + NaCl), 22 ± 1°C: $K = K_S F_{EX}^a / F_{H+}^b$ where F_{EX} and F_{H+} are the concentrations, in formality units, of extractant and hydrogen ion, respectively, and a and b are, respectively, the extractant dependency and hydrogen ion dependency of K for the cation considered. The K_S values are discussed in terms of the state of aggregation of the extractant, HDHoEP, in four diluents: n-decanol, methyl isobutyl ketone (Hexone), benzene, and n-heptane. The extractant is assumed to be monomeric in the first, dimeric in the next two and more highly polymeric (perhaps consisting of dimers, trimers and tetramers) in the last diluent. (auth)

22017 THERMODYNAMICS OF THE HYDROGEN ISOTOPE SORPTION ON SYNTHETIC ZEOLITES. Parbuzin, V. S.; Panchenkov, G. M. (Moscow State Univ.). Isotopenpraxis, 3: 56-62(Feb. 1967). (In Russian).

The low-temperature sorption of the isotopic hydrogen molecules: protium, deutero-protium, deuterium on industrial synthetic zeolites of type A, X, Y was studied in temperature range from 62 to 90°K and of equilibrium pressures from 5 to 350 mm Hg by using simultaneously kinetic, adsorption, and isotopic methods. Exchange heat and entropy of the isotopic molecules $D_2 - H_2$, $D_2 - HD$, $HD - D_2$ in gaseous and adsorption phases were determined from the separation factor as a function of temperature; for the pair $D_2 - H_2$ the enthalpy of exchange determined in this way is in good agreement with the differences of isosteric sorption heats calculated from the sorption isotherms of hydrogen and deuterium, individually. It is stated that the high selectivity of the zeolites investigated with respect to the hydrogen isotope sorption is due not to molecular-sieve effects, but to the thermodynamic equilibrium factors. (auth)

22018 ISOTOPE ELECTROMIGRATION IN ION EXHANGERS. II. ENRICHMENT OF LITHIUM ISOTOPES BY ELECTROMIGRATION IN A CATION-EXCHANGE MEMBRANE. Okamoto, Makoto; Kakihana, Hidetake (Tokyo Inst. of Tech.). Nippon Kagaku Zasshi, 88: 313-16(Mar. 1967). (In Japanese).

The possibility of "semi-continuous" separation of lithium isotopes by the electromigration method was investigated. Isotopic effects on the migration velocity and the diffusion of bands were studied in the system involving three bands in a cation exchange membrane. The three band system such as (+) NH_4-R ... Li-R ... NH_4-R ... Li-R ... NH_4-R ... Li-R ... NH_4-R (−) was easily prepared with an electromigration apparatus. The three bands were migrated about 40, 20, and 10 cm, respectively. The amounts and the isotopic ratios of lithium were determined by previously described methods. The single process enrichment factor at 25°C was estimated as 1.01 + 0.002 which was nearly independent upon the migration distance and velocity, but depended upon the temperature. This value agrees with a theoretical one based on the "root effect" of hydrated lithium ions. According to these results it may be concluded that the "semi-continuous" separation is applicable for the lithium isotope separation. (auth)

22019 ANION EXCHANGE AND A SELECTIVITY SCALE FOR ELEMENTS IN SULFURIC ACID MEDIA WITH A STRONGLY BASIC RESIN. Strelow, F. W. E.; Bothma, C. J. C. (South African Council for Scientific and Industrial Research, Pretoria). Anal. Chem., 39: 595-9(May 1967).

Anion exchange equilibrium distribution coefficients with Bio-Rad AG1-X8, 100- to 200-mesh, a quaternary ammonium resin in the sulfate form, are presented for 52 elements in sulfuric acid media. The acid concentration range from 0.01 to 4.0N is covered. Coefficients for elements with strong hydrolytic tendencies like Ta(V), Nb(V), and W(VI) are determined in the presence of H_2O_2. The elements are arranged arbitrarily into a selectivity scale according to the distribution coefficients in 1.0N acid, or according to the coefficients at 0.1 or 0.01N acid when the coefficients are <1 at the higher acid concentrations. Included are elution curves for the multicomponent systems Y(III) – Th(IV) – U(VI) – Mo(VI); Th(IV) – Hf(IV) – Zr(IV) – Mo(VI); and Cr(III) – V(V) – Mo(VI) – W(VI) to demonstrate some possibilities inherent in the above anion exchange system. Some aspects in the elution behavior of various elements are discussed. (auth)

22020 PREPARATION OF CARRIER-FREE SILVER FROM PROTON-IRRADIATED PALLADIUM. Shiokawa, Takanobu; Yagi, Masuo; Sasaki; Teikichi; Hishinuma, Noboru (Tohoku Univ., Sendai). J. Nucl. Sci. Technol. (Tokyo), 3: 549-50(Dec. 1966).

A procedure was developed for separating the isotopes ^{105}Ag and ^{105m}Ag from Pd targets irradiated with 10-MeV protons. The procedure comprises dissolving the Pd metal target, separating the Pd on an anion resin, and depositing the Ag isotopes electrolytically for use as radiation sources. (D.L.C.)

22021 APPLICATION OF RADIOISOTOPES IN COLUMN CHROMATOGRAPHY ON SUBSTITUTED CELLULOSES. VI. THE SEPARATION OF ANTIMONY FROM MANGANESE, IRON, AND OTHER METALS. Muzzarelli, R. A. A.; Marcotrigiano, G. (Univ. of Sherbrooke, Can.). Talanta, 14: 489-94(Apr. 1967).

The chromatographic behaviour of nanogram amounts of antimony in ethyl ether medium was studied by radioisotope techniques (^{125}Sb) on cellobiose, cellulose, and seven substituted celluloses. It was found that antimony is strongly retained and can be separated from macro amounts of manganese, iron, gold, uranium, mercury, arsenic, and several other metals. Antimony could be quantitatively recovered by elution from natural cellulose and cellobiose. The method can be applied in several analytical problems concerning the separation of traces of antimony. (auth)

22022 PARTITION CHROMATOGRAPHIC STUDIES OF AMERICIUM, YTTRIUM, AND THE RARE EARTHS IN THE TRICAPRYLYLMETHYLAMMONIUM THIOCYANATE–AMMONIUM THIOCYANATE SYSTEM. Huff, E. A. (Argonne National Lab., Ill.). J. Chromatogr., 27: 229-36(Mar. 1967).

The system Aliquat-336 (tricaprylylmethylammonium thiocyanate)–ammonium thiocyanate was investigated by column partition chromatography. The distribution coefficients for americium, yttrium, and the rare earths were found to increase with thiocyanate concentration and percentage of Aliquat-336. A decrease in extraction was noted with increased acidity of the aqueous phase. Separation factors for adjacent rare earth elements ranged from 1.3 to 2.0. Some practical separations using this system are indicated. (auth)

22023 HYDRATION OF THE ORGANIC PHASE IN EXTRACTION OF URANIUM WITH ORGANOPHOSPHORUS REAGENTS. Kuca, L. (Inst. of Nuclear Research, Prague). Collect. Czech. Chem. Commun., 32: 720-8(Feb. 1967).

The degree of hydration of tri-n-butyl phosphate (TBP), trihexylphosphine oxide (THPO), di-n-butylphosphoric acid (HDBP) and a THPO–HDBP mixture and complexes of uranyl nitrate with HDBP, THPO, and HDBP was determined in carbon tetrachloride solutions at concentrations $\leq 0.1\underline{M}$. The aqueous phase was water, $1\underline{M}$ HNO_3 and $0.5\underline{M}$ H_2SO_4. For the formation of the hydrates of TBP, THPO, and HDBP the equilibrium constants were determined. The uranyl complexes mentioned are partially hydrated in dilute solutions. (auth)

22024 USE OF SACCHAROSE IN THE CONCENTRATION OF LIQUID RADIOACTIVE RESIDUES AND IN THE RECOVERY OF FISSION PRODUCTS. Ortega Abellan, J.; Ramos Salvador, L. (Junta de Energia Nuclear, Madrid). An. Real Soc. Espan. Fis. Quim. (Madrid), Ser. B, 63: 345-52(Mar. 1967). (In Spanish).

Sugar was used in removal of nitric acid from Purex liquid wastes. Vanadium salts, 10^{-3} to 10^{-2} $\underline{M}$, catalyzed this reaction. Simulated Purex wastes were concentrated by evaporation, by a factor of 100, using sugar to destroy nitric acid and ammonium vanadate. The nitric acid molarity remained below 3 during the process. The final results indicated a yield of 22 moles of HNO_3 destroyed per mole of sugar. In the presence of vanadium, the corrosion products did not affect the reaction. Since sugar reaction products (oxalic acid, tartaric acid ...) are good complexing agents of fission and corrosion products, no precipitation occurred when the concentrated solution brought to pH 4 to 13, with caustic, in order to recover Sr-90 and Cs-137. (auth)

22025 SCAVENGING OF RADIONUCLIDES IN SEA WATER BY THE USE OF MANGANESE DIOXIDE AND OTHERS. Momma, Toshiko; Iwashima, Kiyoshi (Inst. of Public Health, Tokyo). Radioisotopes (Tokyo), 16: 68-72(Feb. 1967). (In Japanese).

Efficiencies with which trace quantities of ^{60}Co, ^{106}Ru, and ^{65}Zn in sea water are precipitated were examined for scavengers such as manganese dioxide and hydroxides of iron(III), iron(III)–magnesium, and iron(III)–manganese(II). These scavengers were made and dried at 90 to 100°C and then put into sea water. Efficiencies of iron hydroxide were low for ^{60}Co precipitation. Iron–magnesium and iron–manganese hydroxides showed high efficiencies for all of these tracers, but were found difficult to filter. The highest practicability was found in commercial granular α-manganese dioxide. As the removal of these tracers from manganese dioxide was found most difficult at pH 7 to 8, no pretreatment is required in dealing with sea water of normal pH. Only 0.2 g of this scavenger (50 to 100 mesh) can precipitate these tracers almost completely from 50 ml of sea water in about an hour of agitation. (auth)

22026 A CONTINUOUS CATHODIC REFLUX METHOD FOR THE SEPARATION OF LITHIUM ISOTOPES BY COUNTERCURRENT EXCHANGE ELECTROLYSIS. van Bennekom, A. J.; Arkenbout, G. J.; Smit, W. M. (Inst. for Physical Chemistry, TNO, Utrecht). Ber. Bunsenges. Phys. Chem., 71: 215-18 (Apr. 1967).

Properties of n-propylamine were investigated as solvent for the electrolyte phase in separation of lithium isotopes by means of countercurrent exchange electrolysis (CCEE). The vapor-liquid equilibrium diagram of the system n-propylamine–water was determined. From this diagram it was derived, that a transfer of lithium salts from n-propylamine into water combined with a complete recovery of sufficiently waterfree propylamine can be obtained by means of a simple stripping column. Combination of this stripping column with a continuously operating electrolyzer led to a completely continuous cathodic reflux system. An electrolyzer was developed. The application of a mercury-jet electrode and the introduction of a pretreated tube of an iron–nickel–cobalt alloy in the amalgam outlet appeared to be important improvements. The complete setup was tested in a separation experiment lasting 60 hr, during which time the lithium-6 content of the reflux section decreased from 7.4 to 4.2%. The elementary separation factor derived from CCEE experiments without reflux appeared to be 1.048 ± 0.013. (auth)

22027 EXTRACTION OF SOME RARE EARTHS WITH TRIOCTYLAMINE FROM COMPLEXED AQUEOUS PHASE. Werner, Gerhard; Altendorf, Rolf; Holzapfel, Heinz (Karl-Marx-Univ., Leipzig). J. Prakt. Chem., 34: 201-8(1966). (In German).

Rare earths were extracted from aqueous solutions containing $LiNO_3$ with trioctylamine in benzene. The dependence of the partition coefficient on the atomic number allowed use of complex formation in the aqueous phase in order to improve the separation. Data for La, Ce, Pr, and Nd with ethylenediaminetetraacetic acid and hydroxyethyliminodiacetic acid in the aqueous phase are graphed. The separation factor was shown to increase with increasing concentration of complexing agent. The preparation of Pr fractions free from Nd was accomplished with the Craig fractionation technique. A complete separation was not achieved because of the small separation factor and the small number of steps carried out. Behavior of components in the Craig separation was far from ideal; reasons for this behavior are discussed. (BBB)

EARTH SCIENCES

Geology

Refer also to abstracts 22041, 22052, 22053, 22117, 22184, 22198, 22234, and 23030.

22028 ANNEALING OF TRACKS FROM SPONTANEOUS FISSION OF URANIUM IN MICA CRYSTALS AND GLASS. Berzina, I. G.; Vorob'eva, I. V.; Geguzin, Ya. E.; Zlotova, I. M. (Kharkov State Univ.). Dokl. Akad. Nauk SSSR, 171: 1313-16 (Dec. 21, 1966). (In Russian).

Individual etch tracks of fission fragments in muscovite were followed microscopically. On etching the tracks were visible as prisms with a rhombic cross-section. The diagonal of the rhomb d and the visible track length L increased with increasing etching time. These dimensions were found to decrease on annealing the muscovite at various temperatures (from 200 to 700°C) for one hour. The higher the annealing temperature, the smaller the track length. A similar behavior of fission fragments in glass was also observed. (TTT)

22029 XENON AND KRYPTON ISOTOPES IN STONY METEORITES. Gerling, E. K.; Shukolyukov, Yu. A.; Ashkinadze, G. Sh.; Komarov, A. N.; Tolstikhin, I. N. (Lab. of Precambrian Geology, Leningrad). Geokhimiya, No. 4, 387-98(Apr. 1967). (In Russian).

An enrichment in ^{136}Xe accounted for by ^{244}Pu fission, was found in a black fraction of the enstatic chondrite Kunashak and in the magnetic fractions of the hypersthenic meteorite Saratov and of the crystalline chondrite Elenovka. The meteoritic Kr is enriched in ^{86}Kr, ^{83}Kr, and ^{82}Kr in relation to ^{84}Kr. This effect is caused by reactions due to cosmic-irradiation. Tracks of nuclei with great mass and energy were detected in meteorites. There is anisotropy in the track direction. (auth)

22030 BEHAVIOR OF WATER IN SOIL AGGREGATES. II. UNDER UNSATURATED CONDITION. Ojima, Tsutomu; Toratani, Hirokazu (Radiation Center of Osaka Prefecture, Japan). Nippon Dojo Hiryogaku Zasshi, 36: 339-42(Nov. 1965). (In Japanese).

Tritiated water was used as a tracer to investigate the movement of water through a soil aggregate column under several unsaturated conditions in the laboratory. The content of water was controlled at a certain level during an experimental period by dropping tritiated water onto the top of the aggregate column, shorter in length than the capillary rising height. The breakthrough curves of tritiated water and the amount of immobile water were obtained. The varying shape of the curves appeared to be attributable to the differences in the distribution of microscopic flow velocities in the unsaturated column with several water contents. The amounts of immobile water ranged from 0.0 to 2.5 cm^3, while the amounts of water in the sample were from 30 to 50 cm^3. It appeared that the water existed with that newly supplied during the experimental period. (NSA of Japan)

22031 ISOTOPIC INDICATORS IN THE INVESTIGATION OF UNDERGROUND WATER FLOW. Krotowicz, Jerzy (Inst. of Geology, Warsaw). Przegl. Geol., 15: 30-5(Jan. 1967). (In Polish).

Several methods of investigating underground water flow by means of isotope indicators are discussed. Methods based on both radioactive and stable isotopes detected by activation analysis are listed. Principles of selection of indicators to investigate water flows, techniques applied to avoid losses caused by sorption, and techniques for the selection of appropriate indicators, and ways of detecting various indicators used during investigations are discussed. Perspectives of practical use of the individual research methods are also taken into consideration. (tr-auth)

22032 SOME PECULIARITIES IN THE DISTRIBUTION OF NATURAL RADIOACTIVE ELEMENTS IN CARBONATE ROCKS. Larionov, V. V.; Shvartsman, M. D. (Moscow Inst. of Oil-Chemical and Gaseous Industry). Geokhimiya, No. 2, 221-7 (Feb. 1967). (In Russian).

The distribution of Ra, Th and K in mesozoic sediments of the Caucasus was studied. Compared to pure limestones secondary dolomites are characterized by a heightened content of radium at a minimum content of thorium and potassium. Such a distribution of radioelements, being conditioned by the genetic properties of dolomites under investigation, allows them to be distinguished on the basis of the Ra, Th and K ratios. Radium and thorium are prevailingly connected with aleurite-like particles (d_3 = 5 to 10 μ), but potassium is mainly confined to argillaceous fractions (d_3 < 1 μ). (tr-auth)

22033 DEEP WATER ISOTOPIC CURRENT ANALYZER 1B(DWICA-1B) (Engineering Materials). (Johnston (William H.) Labs., Inc., Baltimore, Md.). (CAPE-1491).

74 drawings.

A deep water isotopic current analyzer (DWICA-1B) is described which is used to study in situ flow conditions in reservoirs and lakes with very low velocity. DWICA-1B works on the principle of the salt-velocity method for flow gaging using ^{131}I for the tracer instead of salt. Time of travel for the drifting tracer is measured over a known distance and the average water velocity in the drift-path is calculated. The tracer is injected in the center of a circle of 12 equally spaced detectors and the current direction is established from the knowledge of which detector produces the largest response to the passage of the tracer. The apparatus is capable of accurately measuring current speeds in the ultra low range of velocities from 0 to 0.2 ft/sec at depths to 350 ft. It has recorded velocities down to 0.003 ft/sec at depths of 400 ft. The equipment is rugged enough to withstand adverse weather conditions and rough handling in the field. It is applicable under conditions of unsteady flow. (For details see TID 4100 Suppl. 40.) (F.S.)

Meteorology

Refer also to abstract 22064.

22034 (AD-643534) DEVELOPMENT OF AN IMPROVED LAND-SURFACE FALLOUT MODEL. PART I. INTRODUCTION AND SUMMARY. Final Technical Report, March 31, 1965-January 31, 1967. Norment, H. G.; Schwenke, T. W.; Kohlberg, I. (Technical Operations, Inc., Burlington, Mass.). Dec. 1966. Contract DA-28-043-AMC-01309(E). 45p. (TO-B-66-80; ECOM-01309-F). CFSTI $3.00 cy, $0.65 mn.

A design for the overall Department of Defense Land Fallout Prediction System (DELFIC) was completed and successfully tested by operation on the IBM 7094 computer. Several of the major component parts of the system were developed in their entirety including the Initial Conditions Module and the Transport Module, and the Output Processor Module. In addition, an extensive effort was devoted to development of a cloud rise model that is appropriate for use with the DELFIC system; the model is to be used in the initial version of the system. (TAB)

22035 (AD-644597) ARTIFICIAL RADIOACTIVITY REFERENCE HORIZONS IN GREENLAND FIRN. Crozaz, G.; Langway, C. C.; Picciotto, E. (Army Cold Regions Research and Engineering Lab., Hanover, N. H.). Aug. 1966. 15p. (RR-208). CFSTI $3.00 cy, $0.65 mn.

Total beta measurements have been made on melt water samples from a stratigraphically dated firn core profile from the inland Greenland ice sheet (77 deg 10 min N, 61 deg 08 min W). A marked increase in radioactivity is found in the 1953 firn layer which corresponds to the first important fallout from nuclear test bombs. The pre-1953 natural beta activity is 5 dpm/kg. The influx of artificial debris from the Ivy tests in 1953 is noted by a sharp rise in beta activity to 10 dpm/kg. Total ^{90}Sr deposit to June 1964 is 9.3 plus or minus 1.5 millicuries/km^2 (24 plus or minus 4 mC/mi^2). Average ^{210}Pb activity at time of deposit is 3.9 plus or minus 0.4 dep/kg. (TAB)

22036 (BNWL-SA-1146) COSMIC RAY PRODUCED RADIONUCLIDES AS TRACERS OF ATMOSPHERIC PRECIPITATION PROCESSES. Wogman, N. A.; Thomas, C. W.; Cooper, J. A.; Engelmann, R. J.; Perkins, R. W. (Battelle-Northwest, Richland, Wash. Pacific Northwest Lab.). Mar. 6, 1967. Contract AT(45-1)-1830. 12p. (CONF-670310-1). Dep. mn. CFSTI $3.00 cy, $0.65 mn.

From American Meteorological Society Meeting, Ann Arbor, Mich.

Cosmic ray-produced ^{34m}Cl, ^{38}Cl, ^{39}Cl, ^{35}S, and ^{24}Na were measured in rain and snow and their absolute concentrations determined. Absolute concentrations are related to the scavenging efficiency and the altitude from which precipitation occurred while relative concentrations provide information on the time spent by the raindrops subsequent to nucleation in the cloud but prior to deposition at the earth's surface. (F.S.)

22037 (EUR-3166.e) REPORT ABOUT CLIMATOLOGY OF DIFFUSION AT ISPRA. Santomauro, L. (Brera Astronomical Observatory, Milan (Italy). Geophysical and Meteorological Dept.). 1966. 186p. Dep. mn.

The hydrologic aspects, including lake currents and thermic conditions, of the southern area of Lake Maggiore; the meteoro-

logical characteristics, including weather types and seasonal variations, of northern Italy; and the microclimatic and thermodynamic characteristics of the Ispra area with emphasis on wind profiles in relation to lapse-rate, and the wind speed are discussed. The mean thickness of the atmospheric boundary layer for the Ispra area was studied in relation to the diffusion of gaseous effluents. Atmospheric diffusion of radioactive effluents, effective stack heights, and the calculated values of Kr and Xe concentrations for various atmospheric equilibrium conditions of the reactor were calculated. The influence of topography on radioactive airborne diffusion is discussed. (F.S.)

22038 (EUR-3167.d) DIE METEOROLOGISCHEN BEDINGUNGEN DER AUSBREITUNG LUFTFREMDER STOFFE IN ISPRA/ITALIEN BEI DEN REAKTOREN DER EURATOM. (Meteorological Conditions Governing the Propagation of Air-Contaminating Substances Released from the EURATOM Reactors at Ispra, Italy). Diem, M.; Zedler, P.; Weisweiler, W.; van der Linde, K. H. (Technische Hochschule, Karlsruhe (West Germany). Meteorologisches Institut). 1967. 120p. (In German). Dep. mn.

The wind direction at Ispra is influenced predominantly orographically by the mountain and valley winds and in winter by the foehn. The average wind speed doubles between ground level and a height of 120 m. The daily trend reveals a two-layer system which is likewise determined by the orography. Calms are very frequent, with a preferential light breeze layer between 30 and 60 m. With the occurrence of the opposing wind system, the propagation of dust and gas depends largely on the height of the source. (tr-auth)

22039 (HASL-181(App.)) FALLOUT PROGRAM QUARTERLY SUMMARY REPORT, DECEMBER 1, 1966-MARCH 1, 1967. Appendix. [Hardy, Edward P. Jr.; Rivera, Joseph] (New York Operations Office (AEC), N. Y. Health and Safety Lab.). Apr. 1, 1967. 218p. Dep. mn. CFSTI $3.00 cy, $0.65 mn.

Tabulations of data are presented on fallout monitoring for the period December 1, 1966 to March 1, 1967. Data are presented on the monthly deposition of ^{89}Sr and ^{90}Sn at world land sites; fission product and activation product radionuclides deposited monthly at selected sites; radiostrontium deposition at Atlantic Ocean weather stations; and radiostrontium in milk and tap water. Tables of conversion factors and radionuclides involved in the fallout and air sampling programs are also given. (R.C.K.)

22040 (IA-1076) 1963 METEOROLOGICAL DATA FOR THE IRR-1 REACTOR SITE. Rosental, N.; Tal, A.; Surkes, M. (Israel Atomic Energy Commission, Yavne. Soreq Nuclear Research Center). Jan. 1966. 11p. Dep. mn.

Meteorological measuremenis taken in 1963 at the IRR-1 reactor site at Nahal Soreq, Israel are presented in tabular form. Information on wind direction and velocity, atmospheric temperature, and frequency and amount of precipitation is given. (L.C.L.)

22041 (MLM-1391) ENVIRONMENTAL MONITORING REPORT: JULY-DECEMBER 1966 AND 1966 SUMMARY. Anderson, H. F.; Sheehan, W. E. (Mound Lab., Miamisburg, Ohio). Feb. 10, 1967. Contract AT(33-1)-Gen-53. 23p. Dep. mn. CFSTI $3.00 cy, $0.65 mn.

The concentration of radioactive materials detected in the environment surrounding Mound Laboratory, Miamisburg, Ohio, is presented for the second half of 1966 and a summary is presented for the entire year. The concentration of radionuclides from Mound Laboratory in the Great Miami River and in the environmental air was within the standards specified by the Atomic Energy Commission. (auth)

22042 (NYO-3685-7) OBSERVATIONS ON PLUME RISE FROM A LARGE INDUSTRIAL STACK. Research Report No. 1. Slawson, P. R. (Waterloo Univ. (Ontario). Dept. of Mechanical Engineering). May 1966. Contract AT(30-1)-3685. 87p. Dep. mn. CFSTI $3.00 cy, $0.65 mn.

Careful photographic observations were made on the rise of smoke plumes from Lakeview Generating Station, Ontario and the results were compared with several theoretical formulae. Data relating to the stack variables were collected in some detail. In a neutral atmosphere a linear rising portion of the plume was found to occur beyond a specific transition point. Within the limited accuracy of the photographic technique, the observations confirmed the theoretical result that the height of the plume axis above the source varies as the two-thirds power of the distance downwind. Increased dilution tended to oppose plume rise but the direct effect of instability in the atmosphere was to promote rise; under these opposing influences it was found in a dynamically unstable atmosphere that the plume was sometimes above and sometimes below a corresponding plume in neutral conditions. (auth)

22043 (NYO-3685-10) DIFFUSION IN BUOYANT CHIMNEY PLUMES. Annual Report, 1966. (Waterloo Univ. (Ontario). Dept. of Mechanical Engineering). Jan. 1967. Contract AT(30-1)-3685. 92p. Dep. mn. CFSTI $3.00 cy, $0.65 mn.

The development of experimental facilities and techniques are described for studies on the "mean path" of buoyant plumes in a horizontal wind, flow patterns within a buoyant plume, and gravitational settling of heavy particles from buoyant plumes. In a study of the settling of dust particles borne by hot plumes, it was found that the mean path of the dust plume as it settles from the hot plume indicates some effect of buoyancy on the dust particle fallout, and that turbulence in the hot plume delays the fallout of certain size particles diffusing them upwards. It was found that for two-dimensional starting plumes, the advancement of the plume is proportional to time, that unless the inflow initial momentum is large the density difference is slight and the effect of initial momentum may be neglected shortly after the plume is released, that in a dimensionless form, the velocity fields of starting plumes are identical, that a starting plume consists of a cylindrical cap and a wedged tail, and that for the motion in the ambient fluid, an inviscid flow model may be proposed which consists of a line sink along the tail and a doublet and a source at the center of the plume cap. (F.S.)

22044 CALCULATING THE AVERAGE SPECIFIC RADIOACTIVITY IN THE AIR OF THE SURROUNDINGS OF A NUCLEAR POWER STATION. Sauter, E. (Siemens-Schuckertwerke AG, Erlangen, Ger.). Atompraxis, 13: 82-5(Feb. 1967). (In German).

The concentration of radioactivity in the air surrounding a nuclear power station is generally calculated by means of the Sutton equation modified by Pasquill. This equation assumes constant wind direction. In actual fact, however, there are always fluctuations in the wind directions. Consequently the mean concentration of radioactivity which accounts for the biological effect will be less than the value χ calculated according to the equation mentioned above. Factors are found for multiplying the values χ in order to obtain the mean concentrations. The limits of the method are shown. (tr-auth)

22045 CONCENTRATIONS OF CHLORIDE AND DEUTERIUM IN RAINWATER AS A FUNCTION OF RAINDROP DIAMETER AND THEIR RELATIONSHIP TO RAINFALL INTENSITY. Komabayasi, M.; Gonda, T. (Nagoya Univ., Japan). J. Meteorol. Soc. Japan, 42: 354-61(Dec. 1964).

Rainwater was collected according to drop size by using the raindrop spectrograph devised by Bowen and Davidson. Chemical composition was measured and compared with intensity of rainfall over each range of drop size. For large raindrops, it was found that the concentration of chloride in rainwater increased with an increase in intensity of rainfall. For small raindrops the concentration of chloride in rainwater decreased with an increase in intensity of rainfall. In some samples of rainwater, the concentration of deuterium was measured. Concentration of deuterium varied with the size of the raindrops. Concentration of deuterium was maximal in the range of raindrop size corresponding to a mean dia of 0.7 mm. To estimate the amount of chloride collected as dry fallout, distilled water was exposed in the air stream of the raindrop spectrograph. Extent of contamination of the exposed distilled water was determined chemically, and a correction for chloride content in rainwater was made by subtracting the amount of the chloride contamination from the chloride content of the rainwater in collectors. (BBB)

22046 MEASUREMENT OF TRITIUM ACTIVITY IN NATURAL WATERS. PART II. CHARACTERISTICS OF GLOBAL FALLOUT OF ^{3}H AND ^{90}Sr. Athavale, R. N.; Lal, D.; Rama (Tata Inst. of Fundamental Research, Bombay). Proc. Indian Acad. Sci., Sect. A, 65: 73-103(Feb. 1967).

The concentrations of tritium have been determined in wet precipitations occurring over the Indian subcontinent during 1961 to 64. The tritium concentrations varied significantly during the period of observation; highest concentrations were observed during 1963. An analysis of the data reveals that the nuclides ^{3}H and ^{90}Sr, which were originally placed at high altitudes in the polar regions during late 1962, were deposited chiefly at 30 to 90° latitudes during 1963 and 1964 respectively in relative proportions of 1 and 0.6. The data show that the largest gradients in their zonal deposition occur at about 35 to 40° N latitude and that to a first approximation, their deposition per unit area in 1963 or 1964 was practically uniform, separately in the 30 to 90° and 0 to 30° latitude regions. The annual deposition rates of ^{90}Sr as observed during 1963 and 1964 suggest a mean time of 3 months for exchange of air between the two cells, is in good agreement with the values deduced for mid-months of the year on the basis of analysis of bomb produced ^{14}C data. The tritium and strontium data for the inland, coastal and island stations are analyzed to evaluate the importance of re-evaporation of tritium from continents and the molecular exchange of atmospheric tritium with oceanic water. The estimated concen-

tration of ^{3}H in evaporated water suggests that the precipitated water mixes very slowly with that in the soil. The relative wet deposition of ^{3}H and ^{90}Sr at island and coastal stations is similar to their estimated concentration ratio in upper level tropospheric air. The relative concentrations of ^{3}H and ^{90}Sr at continental and oceanic stations differ only to the extent expected due to reinjection of ^{3}H over continents. The mean annual concentration of ^{90}Sr in wet precipitation is lower at oceanic stations compared to that at continental stations. This could be due to meteorological effects peculiar to oceanic areas, e.g., higher rainfall and quick recycling of evaporated water. Otherwise, a significant removal of ^{90}Sr (and ^{3}H) by ocean spray and jet action must occur. (auth)

22047 ON A METHOD FOR MEASURING RADIOACTIVITY OF PARTICLES OF PRECIPITATION AND SOME PRELIMINARY RESULTS OF THESE INVESTIGATIONS. Styro, B. I.; Vebriene, B. (Academy of Sciences, Vilnius, Lithuania). Izv. Akad. Nauk SSSR, Fiz. Atmos. Okeana, 2: 1055-63(1966). (In Russian).

An autoradiographic method of measuring radioactivity of raindrops and ice crystals is described whereby they are caught on polished steel plates and placed in contact with a nuclear emulsion of the A-2 type. The number of nonradioactive droplets was determined and it was shown that in continuous rains the percentage of nonradioactive droplets for one series of measurements was 27 to 32% and for another 42%. Radioactivity of individual droplets increased, on the average, with the increase of droplet size. It was also shown that the sp radioactivity of droplets increased in an exponential curve with the decrease of droplet size. On the basis of this finding, the mean value for relative evaporation of droplets was calculated for the time from their leaving the cloud to their reaching the earth. (BBB)

22048 ROLE OF METHYLENE IN THE PRODUCTION OF ATMOSPHERIC TRITIATED METHANE. Cadle, R. D. (National Center for Atmospheric Research, Boulder, Colo.). J. Geophys. Res., 72: 2251-3(Apr. 15, 1967).

Tritiated methane in the atmosphere results from tropospheric exchange of methane with tritiated hydrogen that has mixed downward from the stratosphere. Specifically, it is suggested that methylene may be produced from methane by electrical discharges and other ionization processes in the lower atmosphere. An experimental investigation was performed to determine whether any atmospheric constituents would react preferentially with methylene preventing its reaction with tritiated hydrogen. It was concluded that it is highly unlikely that reactions of methylene produce tritiated methane in the atmosphere. (R.C.K.)

22049 RADIOACTIVITY DISTRIBUTION OF EMANATION DECAY PRODUCTS BETWEEN AEROSOL PARTICLES OF DETERMINED SIZE RANGES. Flattau, Jan; Rutkowska, Krystyna. Prace Cent. Inst. Ochrony Pracy, 17: No. 52, 45-58(1967). (In Polish).

Fractional analysis of aerosol particles was carried out in air as well as in air filtered through Whatman 41 paper; a thermoprecipitator and electron microscope was employed. The relative activities attached to these particles were also measured. Millipore filters and scintillation counters were used for this purpose. The distribution of radioactivity between the ranges of aerosol particles was established on the basis of data achieved. (auth)

22050 COMPARISON OF ESTIMATED AND MEASURED LONG-TERM ^{131}I CONCENTRATIONS FROM A CONTINUOUS ELEVATED SOURCE. Smith, M. E.; Hull, A. P.; Nagle, C. M. (Brookhaven National Lab., Upton, N. Y.). Contract AT(30-2)-Gen-16. J. Appl. Meteorol., 6: 303-8(Apr. 1967). (BNL-10513).

The continuous release of very small, but detectable amounts of ^{131}I from the Brookhaven Graphite Research Reactor has provided an unusual opportunity for verification of dispersion estimates based on meteorological parameters. Analysis of an entire year's data shows the prediction system to be reliable within a factor of 2, and contains valuable information about such factors as effective stack height, the effectiveness of simplified dispersion models, and the variation of dispersion parameters with season and trajectory. (auth)

Mineralogy

22051 (PEL-112) THORIUM IN THE REPUBLIC OF SOUTH AFRICA. von Backstroem, J. W. (Atomic Energy Board, Pelindaba, Pretoria (South Africa)). Dec. 1966. 21p. Dep. mn.

Thorium requirements for future atomic energy purposes are predicted. The occurrence of radioactive ores, their location, chemical contents, and an estimation of the potential reserves in South Africa are described. These ores occur in the pegmatites, carbonatites, sediments, and sands of the country. Assay results from the heavy-mineral bearing deposits are given. The reserves of monazite and thorianite are itemized. (L.C.L.)

22052 HEAVY MINERALS AS GUIDES TO URANIUM-VANADIUM ORE DEPOSITS IN THE SLICK ROCK DISTRICT, COLORADO. Bowers, Howard E.; Shawe, Daniel R. U. S. Geol. Surv. Bull., 1107-B: 169-218(1961).

Heavy-mineral studies were made of sandstone from the Morrison formation of Late Jurassic age in the Disappointment Valley area, Slick Rock district, San Miguel Country, Colo. The studies were made in conjunction with exploratory drilling for U-V deposits in the Salt Wash member. Among the heavy minerals recognized were black opaque minerals (now principally hematite), zircon, tourmaline, apatite, rutile, garnet, leucoxene, barite, anatase, pyrite, and galena. Three distinct lithologic types of sandstone were recognized, all of which contain virtually the same heavy minerals, but in different proportions. Probably shortly after deposition of the Morrison formation and before deep burial, black opaque minerals became oxidized in place, largely to hematite but in part to leucoxene. Some Fe moved locally and was redeposited as hematite films on other detrital grains; although altered, the black opaque minerals were not destroyed. After consolidation of sediments, and after the rocks were faulted, altering solutions moved along the fault zones and converted the light reddish-brown sandstone near the faults to light-gray sandstone by leaching black opaque minerals and the hematite films. Where the solutions moved through light-gray carbonaceous sandstone in the ore-bearing unit, black opaque minerals were similarly leached. In addition, ore minerals, as well as some anatase, pyrite, and galena, were precipitated because of the chemical interaction of the leaching solutions and the stagnant, reducing solutions surrounding areas containing carbonaceous material. (BBB)

22053 RECONNAISSANCE GEOLOGY OF HILAND-CLARKSON HILL AREA, NATRONA COUNTY, WYOMING. Rich, Ernest I. U. S. Geol. Survey Bull., 1107-G: 447-540(1962).

The geology of U-bearing beds was studied in the Hiland-Clarkson Hill area which lies in the eastern third of the Wind River structural basin and includes about 800 mi^2 of the west-central part of Natrona County, Wyo. Rocks ranging in age from Precambrian to Recent crop out along the margins of the basin, and rocks of early Eocene age filled the central part of the basin and lap uncomformably onto older rocks. Strata of Oligocene and Miocene age are exposed south of the basin-margin and lap northward onto older rocks. Only the rock formations of Late Cretaceous and Tertiary age are studied. The Upper Cretaceous series is represented by the Frontier, Cody, Mesaverde, Lewis, Meeteetse, and Lance formations, in ascending order. The Tertiary rocks include, in ascending order, the Fort Union formation of Paleocene age, the Wind River formation of early Eocene age, the White River formation of early Oligocene age, and an unnamed sequence of early and middle Miocene age. Areas of anomalous radioactivity occur in the Wind River and White River formations. Small amounts of U were found in 2 places within the Hiland-Clarkson Hill area, one near the town of Hiland and the other in the White River formation near Clarkson Hill. In general, the percent of U found in rock samples collected from the areas of anomalously high radioactivity was less than the equivalent U. Some water samples contain more U than average and those with the highest amount, exclusive of those from the mineralized areas, are at or near the structurally low synclinal axis of the Wind River Basin. (BBB)

22054 CANADA'S RESOURCES OF NUCLEAR FUELS IN INTERNATIONAL PERSPECTIVE. Griffith, J. W. (Rio Algom Mines Ltd., Toronto). Neue Tech., 9: 1-9(Feb. 1967).

Canadian reserves of U_3O_8 are greater than those of any other country, and virtually of all of it can be for export. However, prospects for future world demands appear to be so great that prospecting for new deposits should begin before the end of the present decade. Past experience in mineral exploration indicates that new uranium discoveries will be made at a rate which will satisfy future world demand, but these explorations are unlikely to occur until consumers are prepared to pay more than the present prices. Canada's future position as a major supplier of uranium is examined in a world setting. (L.C.L.)

22055 CONTRIBUTION TO THE KNOWLEDGE OF THE RADIOACTIVE CONSTITUENTS OF THE WITWATERSRAND CONGLOMERATE. III. CARBONACEOUS SUBSTANCE (THUCHOLITH). Schidlowski, Manfred (Univ., Goettingen, Ger.). Neues Jahrb. Mineral., Abhandl., 106: 55-71(Dec. 1966). (In German).

Polymerized hydrocarbons originally present in the gaseous and/or the liquid state form a characteristic constituent of many U- and Au-bearing conglomerate horizons occurring within the Witwatersrand System (South Africa). They are usually known as carbonaceous matter or thucholite. Polymerization was effected by the α and γ radiation emanating from the uraninite fraction of the rock. Therefore, the material is preferentially concentrated

at the footwall of the conglomerates where most of the uraninite has accumulated as part of the heavy suite. The process of resorption and replacement of uraninite by carbonaceous matter is referred to as thucholitization. It may result in the complete dissolution or digestion of the UO_2 particles by the solid hydrocarbons. More commonly, however, small angular relict bodies tend to survive within the latter. Microprobe studies showed that the U content (and thus the radioactivity) of the carbon material is practically restricted to these remnants of the primary uraninite phase. (BBB)

22056 OXYGEN ISOTOPE RATIOS IN COEXISTING MINERALS OF REGIONALLY METAMORPHOSED ROCKS. Garlick, G. Donald (Lamont Geological Observatory, Palisades, N. Y.); Epstein, Samuel. Geochim. Cosmochim. Acta, 31: 181-214 (Feb. 1967).

The $^{18}O/^{16}O$ ratios of coexisting minerals from a number of regionally metamorphosed rocks were measured, using a bromine pentafluoride technique. Listed in order of their increasing tendency to concentrate ^{18}O, the minerals analyzed were magnetite, ilmenite, chlorite, biotite, garnet, kyanite, muscovite, feldspar, and quartz. The only anomalous sequence detected occurred in a xenolith of schist, in which quartz and garnet have undergone less isotopic exchange with surrounding trondjemite than muscovite, biotite, and ilmenite. Regularities in isotopic fractionation between coexisting quartz, garnet, ilmenite, and magnetite suggest that these minerals crystallized in isotopic equilibrium. With few exceptions, quartz–magnetite fractionations decreased with increasing metamorphic grade. The exceptions were found in rocks showing petrographic evidence of retrogradation. The experimental quartz–magnetite fractionations of O'Neil and Clayton were employed in obtaining estimates of temperature during metamorphism. Pelitic schists containing kyanite and chloritoid or staurolite appear to have crystallized at 520 to 600°C. Local homogeneity in isotopic composition of particular minerals among dissimilar rocks was observed in some areas, and was attributed to isotopic exchange with mobile pore-fluids during metamorphism. (auth)

22057 OXYGEN AND CARBON ISOTOPE STUDIES OF CARBONATITES FROM THE LAACHER SEE DISTRICT, WEST GERMANY, AND THE ALNOE DISTRICT, SWEDEN. Taylor, Hugh P. Jr.; Frechen, Josef; Degens, Egon T. (California Inst. of Tech., Pasadena). Geochim. Cosmochim. Acta, 31: 407-30(Mar. 1967).

Oxygen isotope analyses, given as per mil enrichment in ^{18}O relative to mean ocean water, were obtained for 8 calcites (6.3 to 8.2), 5 sanidines (7.0 to 7.4), 2 noseans (5.6 to 5.8), 4 augites (5.8 to 6.1), and 4 biotites (5.3 to 5.9) from volcanic ejecta in Pleistocene tuffs from the Laacher See district. Rock types studied include soevites, biotite-pyroxenites, foyaites, and alkali-syenites. Also, $^{13}O/^{12}C$ ratios relative to the Chicago PDB standard were determined for the calcites (–6.6 to –7.7) and for several CO_2 gas samples collected in the district (–4.9 to –5.1). There was a small, progressive decrease in ^{18}O and increase in ^{13}C in moving along the postulated magmatic differentiation sequence in the Laacher See rocks, and oxygen isotope fractionations among coexisting minerals are approximately those expected for isotopic equilibrium at "magmatic temperatures." Sanidines and augites in the carbonatites are very uniform in $^{18}O/^{16}O$, with values almost identical to those of feldspars and pyroxenes from gabbroic and ultramafic rocks. The $^{13}C/^{12}C$ ratios of the calcites are also relatively uniform and are 5 to 15 per mil lower than in marine limestones. Carbon isotope ratios of the CO_2 gas samples are similar to values determined for CO_2 wells in Utah and New Mexico. The uniformity of $^{18}O/^{16}O$ and $^{13}C/^{12}C$ in the Laacher See rocks contrasts sharply with previous isotopic studies of carbonatites. Presumably, this is because the Laacher See rocks are geologically young samples brought up explosively from depth, thereby being fresh and free from weathering or hydrothermal alteration. Analysis of calcites from the Alnö area, however, showed uniformity of $^{18}O/^{16}O$ with values of 6.9 to 8.4, almost identical with the calcites from Laacher See. Except for two fine-grained dike rocks, the $^{13}C/^{12}C$ ratios were also very uniform (–5.1 to –7.3). It is concluded that the carbonatites of Laacher See and Alnö were not formed by assimilation of limestone, but derived from gabbroic or ultramafic rocks at depth; they give the best available values for $^{18}O/^{16}O$ and $^{13}C/^{12}C$ in primary igneous carbonatite (+6.0 to +8.5, and –5.0 to –8.0, respectively); and the CO_2 evolving in the Laacher See area, as well as CO_2 well samples from other localities, may well also be primary with $^{13}C/^{12}C$ ratios determined by equilibration with carbonatite calcite at high temperatures. (auth)

22058 PRIMARY OXIDATION VARIATION AND DISTRIBUTION OF URANIUM AND THORIUM IN A LAVA FLOW. Watkins, N. D. (Florida State Univ., Tallahassee); Holmes, C. W.; Haggerty, S. E. Science, 155: 579-81(Feb. 3, 1967).

An Icelandic basalt lava flow has a systematic oxidation variation, formed during the initial cooling, with a resultant maximum oxidation just below the center of the lava. The ratio of thorium to uranium shows a clear dependence on this primary oxidation variation. Between-lava comparisons of thorium and uranium may be critically dependent on the position of the samples in each lava. (auth)

Oceanography

Refer also to abstract 22037.

22059 (RLO–1725-94) MOVEMENT OF SEA-BED DRIFTERS NEAR THE COLUMBIA RIVER. Morse, Betty-Ann; Gross, M. Grant; Barnes, C. A. (Washington Univ., Seattle. Dept. of Oceanography). Mar. 24, 1967. Contract AT(45-1)-1725. 20p. (CONF-670507-1). Dep. mn. CFSTI $3.00 cy, $0.65 mn.

From American Society of Civil Engineers, Seattle, Wash.

Sea-bed drifters were dropped on the continental shelf within 50 km of the mouth of the Columbia River from June to October 1966. Twenty-five percent of these, recovered on nearby beaches and in trawls, provide a first local view of residual movement of identified objects near bottom. The net movement in water deeper than 55 m was north, and that at lesser depths was south and toward the beach. Drifters grounded in considerable numbers on the ocean beach within 5 km north of the north jetty of the Columbia River and also on Clatsop Spit 5 km upriver on its south bank. Relatively few were found on the ocean beach near the south jetty. The movement near shore is in agreement with that deduced for bottom water, considering the prevailing seasonal winds and waves and the intrusion of seawater into the estuary. Still needed to help explain the distribution of local sediments and the temporal changes in their distribution are continuous direct measurements and observations of water and particle movement. (auth)

22060 SOME RESULTS OF A STUDY OF ISOTOPE ^{18}O CONTENT IN THE WATERS OF THE TROPICAL ATLANTIC. Babinets', A. E.; Vetshtein, V. Yu.; Davidyuk, L. A. (Inst. of Geology, Kiev. Inst. of Physical Chemistry, Kiev). Dopov. Akad. Nauk Ukr. RSR, No. 3, 230-2(1967). (In Ukrainian).

A precise mass-spectrometric study was conducted to determine the isotope composition of ocean water by depth, including bottom waters and waters of the benthic sediments of the Tropical Zone of the Atlantic. Results show that a distinct correlation appears with depth between decrease in ^{18}O concentration and the rise in silicic acid content which is, evidently, due to exchange processes at low temperatures. (tr-auth)

22061 KHIMICHESKIE PROTSESSY V MORYAKH I OKEANAKH. (Chemical Processes in Seas and Oceans). Bruevich, S. V. (ed.). Moscow, Izdatel'stvo Nauka, 1966. 179p.

Twenty-four articles are included on physico-chemical studies of sea and ocean waters. Regularities in water salinity, formation, processes of organic accumulations in ocean bottom precipitations, distribution of biological elements in seas and oceans, and geochemistry of radium isotopes in the Black and Azov Seas are discussed. (R.V.J.)

Seismology

22062 (UCRL–50188) SHORT TIME INTERVAL FREQUENCY MEASUREMENTS OF A CONTINUOUSLY CHANGING SINE WAVE. Marks, R. E. (California Univ., Livermore. Lawrence Radiation Lab.). Feb. 27, 1967. Contract W-7405-eng-48. 11p. Dep. mn. CFSTI $3.00 cy, $0.65 mn.

A system was developed to measure the frequency at 1-msec intervals of a sine wave which changed continuously from 25 to 300 kHz within a period of 70 msec. The data were desired in a computer input form. The equipment was developed and successfully used in routine data analysis. The apparatus consists of a series of logic modules. Each module contains a circuit or set of circuits such as a clock, four-bit counter, delay or set of gates which when combined formed the analytic system whose output was in IBM cards. The data were calculated digitally as the amount of time necessary for an integral number of cycles. The data are stored in a magnetic core memory. When the 128-word memory is full, the data are punched onto IBM cards. The system is simple and efficient to use. The accuracy in the stated frequency range is about 0.1%. (auth)

22063 TELESEISMIC SIGNALS CALCULATED FOR UNDERGROUND, UNDERWATER, AND ATMOSPHERIC EXPLOSIONS. Carpenter, E. W. (Berkeley Nuclear Labs., Eng.). Geophysics, 32: 17-32(Feb. 1967).

Estimates of the teleseismic signals from explosions in a

representative range of environments are made. The problem is resolved into four component parts: the source function of the explosion, the elastic effects (including geometric spreading), nonelastic effects, and the influence of the recording system. Source functions appropriate to atmospheric explosions, underwater explosions, and underground explosions in a variety of rock types are derived. The effects of elastic and nonelastic behavior are combined to define a standard propagation path. Using the response of a particular recording system, signals from explosions of several different yields in the various media are calculated. In particular, curves illustrating the variations of signal amplitude with yield are obtained; these show that the relative seismic efficiency of explosions in different media is strongly dependent on yield. The relevance of explosion seismology to earthquake is that it enables the propagation path effects to be defined accurately. (auth)

ENGINEERING

Nuclear Explosions

Refer also to abstracts 22034, 22063, 22107, and 22112.

22064 (AD-643536) SHORT-PERIOD PROPAGATION OF INFRASONIC WAVES FROM NUCLEAR EXPLOSIONS. Meecham, W. C. (RAND Corp., Santa Monica, Calif.). Oct. 1966. Contract SD-79. 30p. (RM-5103-ARPA). CFSTI $3.00 cy, $0.65 mn.

A possible explanation is given for the great time duration of intermediate-period (about one minute) and short-period (less than one minute) acoustic-gravity waves received from nuclear explosions. It is suggested that the signal delay for intermediate periods may be due to refraction from largescale weather fronts, and that the signal delay for short periods may be caused by commonly occurring wind ducts. (TAB)

22065 (NP-16693) SOCIAL INSTITUTIONS AND THERMONUCLEAR WAR: A CASE STUDY OF HIGHER EDUCATION. Final Report. King, Robert B. Jr.; Kleiner, Anna M. (HRB-Singer, Inc., State College, Pa.). Jan. 1967. Contract OCD-PS-66-18. 92p.

An investigation into the post-attack capability of the institution of higher education is presented. The existing higher education system is described in terms of physical and organizational characteristics which render it vulnerable to disruption from nuclear attack. The vulnerabilities were verified by assessing system damage resulting from a hypothetical attack. Operational elasticity inherent in the system was clarified with respect to the post-attack capability of a sample of schools, and countermeasures designed to protect the system and hasten its recovery were developed. (auth)

Facilities and Equipment

Refer also to abstracts 22090, 22857, 23135, 23144, 23151, 23152, and 23155.

22066 (I-A2412-04-1) REVIEW OF INITIAL PUMP STRESS ANALYSIS, LOFT PROGRAM. Herrick, R. Clyde (Franklin Inst. Research Labs., Philadelphia, Pa.). Oct. 1966. Contract AT(30-1)-2539. 31p. Dep. mn. CFSTI $3.00 cy, $0.65 mn.

For Phillips Petroleum Co., Idaho Falls, Idaho.

A critical review of the Bingham Pump is described. The review consists of a data analysis of the pump and an independent computer analysis of stresses under thermal pressure loadings in sections of the pump volute casing to evaluate wall thicknesses. The analysis indicated the presence of thermal stresses in the bearing seal cover which exceed code limits; unsatisfactory bolt stresses; nozzle primary membrane stresses exceeding allowable values; and the need for additional response data for the evaluation of nozzles and bolts. (F.S.)

22067 (LA-3548) CROWBAR CODE. Baker, D. A.; Mann, L. W. (Los Alamos Scientific Lab., N. Mex.). July 1966. Contract W-7405-eng-36. 61p. Dep. mn. CFSTI $3.00 cy, $0.65 mn.

The Crowbar code is designed for the transient analysis of the linear electrical circuits often used in controlled fusion experiments to produce strong sustained magnetic fields by means of charged capacitor energy sources. The computer code calculates the natural periods and decay times and the following as functions of time: currents, voltages, instantaneous energy storage, and energy dissipation rates for each of the appropriate circuit elements. The calculations are made with explicit formulas; no numerical integrations are required. The program is written in FORTRAN IV and is currently being used on a 32K IBM 7094. The output results are presented as printed listings and on 35-mm film. (auth)

22068 (LA-DC-8088) COMPARATIVE EVALUATION OF SIZE A METAL ANODE IGNITRONS. Boicourt, G. P.; Hollen, M. J.; Kemp, E. L. (Los Alamos Scientific Lab., N. Mex.). [1964]. Contract W-7405-eng-36. 15p. (CONF-661016-34). Dep. mn. CFSTI $3.00 cy, $0.65 mn.

From Symposium on Engineering Problems of Controlled Thermonuclear Research, Gatlinburg, Tenn.

Eighteen size A metal anode ignitrons from three different manufacturers were evaluated in a standard test circuit. Six different tube types were represented. The test circuit was a 5-μF, 25-kV capacitor mounted with an ultra-low-inductance ignitron header using shorted cables for a load. All tubes were tested at 25-kV charge voltage, peak current 177 kA ringing at 250 kHz with 81% reversal and a repetition rate of 2 shots per minute. The tubes were tested for prefire rate, ignitor life, and ignitor brittleness under these conditions. No single tube type was outstanding in all three categories. The anode material and the glass insulator design for each tube type that was tested is given. Other data show the prefire performance and the ignitor life. An evaluation of the test results is presented. (auth)

22069 (TID-4100(Suppl.37)) ENGINEERING MATERIALS LIST. Supplement 37. Kelly, Robert C. (ed.) (Division of Technical Information Extension (AEC), Oak Ridge, Tenn.). Mar. 1967. 94p. Dep. DTIE Free.

Fifty six packages of engineering materials are announced in this supplement for inclusion in TID-4100. Beginning with this supplement, each supplement will contain a subject index conforming to the style used in Nuclear Science Abstracts. These indexes will be cumulated annually in a separate publication. (F.S.)

22070 (UCRL-70422) GROWING ROLE OF COMPUTERS IN THE NUCLEAR ENERGY FIELD. Fernbach, S. (California Univ., Livermore. Lawrence Radiation Lab.). May 3, 1967. Contract W-7405-eng-48. 25p. (CONF-670501-8). Dep. mn. CFSTI $3.00 cy, $0.65 mn.

From International Conference on Research Reactor Utilization and Reactor Mathematics, Mexico City, Mex.

The use of computers in the nuclear energy field is reviewed from 1950 to the present. The use of computers in nuclear research is doubling each year. Computers are particularly suitable for studies of nuclear weapons, nuclear reactors, controlled thermonuclear reactors, and research on industrial uses of nuclear devices. Small computers for control and data acquisition in nuclear science laboratories are practical. Simulation and design of equipment, experiments and mathematical problems can be accomplished on-line. Computer growth is predicted to continue at its present rate for the next five years. (L.C.L.)

22071 TREATMENT METHOD IN FISSIONABLE MATERIAL REPROCESSING. Fritz, K. (Waagner-Biro AG, Vienna). Neue Tech., 9: 21-6(Feb. 1967). (In German).

The modification of existing technology to meet nuclear requirements and the introduction of new techniques in the design and layout of a fuel reprocessing facility are discussed. Units for the chemical processing of irradiated fuels, such as the two-stage extraction cycle of a Purex plant which consists of two uranyl nitrate evaporators and seven pulse columns, have been designed and manufactured in Belgium. (L.C.L.)

22072 PRESSURIZER DYNAMICS. Drucker, E. E. Atoomenergie Haar Toepass., 9: 38-41(Feb. 1967).

An ideal pressurizer is described and different ways of improving its performance and decreasing the vessel size are discussed. It is theoretically possible to improve performance and decrease pressure vessel size by using steady-state spray with fairly high placement of the heater bundle and by providing a constant temperature heat sink or retaining condensate on the vessel walls. (F.S.)

22073 APPLICATION OF SOFT MAGNETIC MATERIALS IN NUCLEAR RESEARCH. Knorr, W. (Fried. Krupp, Huettenwerke AG, Bochum, Ger.). Z. Angew. Phys., 22: 438-41(1967). (In German).

Soft iron with extra-low contents of alloying additions and of high homogeneity is required in production scale amounts for the manufacture of magnetic components in nuclear research. Magnet yokes take the first place in this respect. The production of forged, laminated and cast yoke magnets is described and chemical compositions of materials used are given. High homogeneity of the material is revealed by test results of numerous casts and by detailed examination of a magnet pole forged from a 70 t ingot of vacuum cast steel. (tr-auth)

22074 THEORY OF THE CNARE EFFECT. Latal, Heimo G. (Illinois Inst. of Tech., Chicago). Ann. Phys. (N. Y.), 42: 352-64(Apr. 1967).

The compression of magnetic fields to more than 2 MG by electrically imploded metal foils, recently demonstrated by E. C. Cnare, is investigated theoretically. The general features of this effect are worked out; and some modifications which may lead to still higher field-compression ratios are discussed. (auth)

22075 THIN GLASS WINDOWS FOR USE IN FAST ELECTRON IRRADIATION VESSELS. Cooper, R.; Kamphausen, H. A. (Univ. of Melbourne). J. Sci. Instrum., 44: 306-7(Apr. 1967).

A method is described for producing thin glass windows down to 0.0004 in. with excellent mechanical protection, high stability to pressure differentials, and good thermal stability. When used with

1.0 MeV electron beams only about 1% of the energy of the beam is lost by scattering and absorption. (UKAE)

22076 USE OF EXPERIMENTAL PLUGS TO IRRADIATE INSTRUMENTED EXPERIMENTS IN THE CORE OF DFR. Campbell, D.; Hobbs, W. R. Nucl. Energy, 40-4(Mar.-Apr. 1967).

In order to use the core region of the reactor for instrumented irradiation tests, special plug designs were developed to replace the 9 in. dia charge plug in the inner rotating top shield. The designs which are described and illustrated allow experiments to be withdrawn telescopically into the plug, permitting movement of the shields and normal charge/discharge operations. The Mk. II plug design houses six experimental rigs in a repeated configuration, a flux monitoring thimble, and four conduits for thermocouples. Experimental irradiations of PuC/UC fuel are described. (UKAE)

22077 KLYSTRON-TO-ACCELERATOR WAVEGUIDE COMPONENTS (Engineering Materials). (Stanford Linear Accelerator Center, Calif.). (CAPE-1561).

10 drawings.

Components are described which are used to transmit and monitor the power that is produced in the klystron tube and to deliver it to the accelerator waveguide where the electron beam is accelerated. These components were designed for the Stanford Linear Accelerator and include vacuum flanges, gaskets, and supports for the waveguide. (For details see TID Suppl. 39.) (F.S.)

22078 COLUMNS FOR MICROSPHERE PREPARATION (Engineering Materials). (Oak Ridge National Lab., Tenn.). (CAPE-1567).

3 drawings.

Three pyrex glass columns are described which are used in glove boxes to prepare microsphere ceramic fuels. A column $\frac{3}{4}$ in. ID which tapers to $1\frac{3}{4}$ in. ID in a length of 12 in. is used to prepare UO_2-PuO_2 microspheres. Microspheres of $^{238}PuO_2$ are prepared in a column with a taper of $\frac{7}{8}$ in. ID to $1\frac{7}{8}$ ID in 16 in. and mixed oxides are prepared in a column with a taper of $1\frac{3}{4}$ in. ID to $3\frac{3}{4}$ in. ID in a 32 in. length. (For details see TID-4100 Suppl. 39.) (F.S.)

22079 OPTICAL ANTIFLASH DEVICE. (to U. S. Atomic Energy Commission). British Patent 1,066,022. Apr. 19, 1967. Priority date Mar. 8, 1962, United States.

A device is described which is capable of protecting the eyesight of personnel subjected to instantaneous and intense light emissions such as those produced by nuclear detonations. Intense light emission in the form of a flash is sensed by a suitable sensor which actuates an explosive mechanism which disperses an opaquing material in a lens or chamber in front of the eyes. The opaquing material in the device protects the eyes of the user. (F.S.)

22080 IMPROVEMENTS IN OR RELATING TO NUCLEAR REACTOR FUEL ELEMENT REPROCESSING. (to Gesellschaft zur Foerderung der Forschung. Eidgenoessische Technische Hochschule). British Patent 1,066,060. Apr. 19, 1967. Priority date Dec. 12, 1962, Switzerland.

Methods and equipment for reprocessing graphite-clad fuel elements of plutonium carbide, thorium carbide, or uranium carbide are discussed. The fuel element is burned in a combustion chamber. During burning it is supported on a perforated grate. The fuel element is burned so that it burns upwards. Ash passes through the grate and is recovered. An exhaust gas conduit, including an electrostatic filter which removes particles of oxides of fissionable material, is provided. (F.S.)

22081 METHOD OF AND DEVICE FOR PRESSURE DIFFERENCE MEASUREMENT. Crehange, Gerard; Mirat, Paul; Bourgoin, Gerard (to CEA). British Patent 1,064,889. Apr. 12, 1967. Priority date Nov. 10, 1964, France.

A method and device are described for the measurement of pressure differences for use particularly, but not exclusively, for the accurate measurement or control of low-pressure differences such as exist between the inside of a glove box and the ambient atmosphere. The level of a liquid dielectric in a capacitor is dependent on pressure differences and this principle is adapted in the device for measuring pressure differences. The capacitor is charged by a predetermined constant current for a predetermined constant time. The resulting voltage across the capacitor at discharge is measured and the value of pressure difference is determined from the discharge voltage. The capacitor is short-circuited to remove the voltage before the next cycle. (F.S.)

22082 IMPROVEMENTS RELATING TO MEANS FOR VIEWING THE INTERIOR OF BORES. Buckley, Frank Hollins (to Fairey Engineering Ltd.). British Patent 1,064,941. Apr. 12, 1967. Filed Sept. 14, 1962.

A method for viewing the interior of a narrow elongated bore such as a fuel channel in the core of a nuclear reactor is described. The method consists of a capsule-type television camera having its lens at one end and its optical axis parallel to the capsule axis, and a remotely controlled conical or pyramidal reflector mounted on the same end of the camera, but beyond the lens. The camera and associated equipment are adapted to be passed into the bore or passage whose surface is to be inspected. (F.S.)

22083 IMPROVEMENTS IN OR RELATING TO SEALABLE PORTS. Delestre, Louis; Lefort, Guy; Pillerault, Jean (to CEA). British Patent 1,065,319. Apr. 12, 1967. Priority date Feb. 10, 1964, France.

A sealable port which is used in a glove box is described. The port consists of a number of bolts or rods regularly spaced around the perimeter of the port moving parallel to the port, and actuated by a single control mechanism. The bolts are spring-loaded for insertion into notches provided for them on an inclined fixed frame. The bolts have casters which roll on the inclined plane when they are engaged causing the displacement of the port perpendicular to its plane, tightening up a sealed joint located between the port and the frame. (F.S.)

22084 CONTAINER FOR A NEUTRON MOISTURE METER. Nakane, Chuichi; Ishimatsu, Kenji (to Hitachi, Ltd.). Japanese Patent 1966-8000. Apr. 20, 1966. Filed Oct. 6, 1959.

An improved container is described for a device such as a neutron moisture meter, in which the fast neutron source (e.g., Ra–Be) and the slow neutron detector (e.g., BF_3 counter) are combined. The container has outer neutron-absorbing outer walls. The interior space where the source and detector are placed is surrounded by the neutron-absorbing walls and the space between the inner and outer walls is filled with a neutron moderator. (NSA of Japan)

22085 DEVICE FOR SUPPLYING A GAS INTO A HIGHLY EVACUATED CHAMBER. Suematsu, Shigeru; Kitabatake, Akihiro (to Hitachi Ltd. Osaka Vacuum Ltd.). Japanese Patent 1966-6665. Apr. 15, 1966. Filed Apr. 19, 1963.

A device is described which is used for maintaining vacuum at a given value in a highly evacuated chamber such as is employed in a particle accelerator or gas evaporating-adsorbing apparatus. The vacuum is maintained at the desired level by introducing minute amounts of gas into the chamber. By making use of the difference in thermal expansion between two metals, the amount of gas supply can be adjusted easily in the range of 0 to several tens cc/hr. The valve body engages with the (valve) spindle by contact between the two in the tapered space (in the valve body). The valve body is made of a metal having a higher thermal expansion than that of the spindle. The outside of the valve body is wound with heating wire. (NSA of Japan)

22086 DEVICE FOR TRANSPORTING A RADIOACTIVE MATERIAL. Ito, Yoshiharu (to Hitachi, Ltd.). Japanese Patent 1966-5853. Mar. 28, 1966. Filed Nov. 7, 1963.

An improved device is described for transporting radioactive materials such as reactor-irradiated nuclear fuels. When replacing reactor fuel, the highly radioactive spent fuel is usually transferred to its cooling pond, either contained in the transport container or by passing through the "water shield." In the device described, however, the spent fuel storage pond and the water tank on top of the reactor are connected, via the spent fuel transport pipe. The spent fuel transport tube runs from the water tank (on top of the reactor) to the bottom of the fuel storage pond, thus connecting the two. In this transport tube are installed a spent fuel receiver and a spent fuel dump case. The receiver and the case are connected, in order, to the arms, the axis of which goes through the transport tube and the lever. By pulling or pushing on the lever, the receiver and the case can be made to lie down or rise to an upright position. (NSA of Japan)

22087 METHOD AND APPARATUS FOR DETERMINING THE AMOUNT OF LEAKAGE FROM CHAMBERS. Gandolfo, Jean-Marie (to EURATOM). British Patent 1,066,004. Apr. 19, 1967. Priority date July 31, 1964, France.

The method and equipment, which are used for the rapid determination of the amount of leakage from chambers such as glove boxes, are described. A tightly sealed standard box is subjected to the same negative pressure as the chamber under test. The standard box is separated from the chamber by one or more cocks and the chamber under test is kept at the same negative pressure as the standard box by evacuation of liquid from a container connected to the chamber under test. The amount of leakage is calculated from the amount of liquid evacuated. (F.S.)

Heat Transfer and Fluid Flow

Refer also to abstracts 22112, 23627, and 23666

22088 (BMwF-FBK-67-08) VERSUCHE ZUR SIMULIERUNG DER WAERMEUEBERTRAGUNG VON DER REAKTOROBER-FLAECHE AN THERMIONISCHE KONVERTER. (Experiments for Simulating Heat Transfer From the Reactor Surface to Thermionic Converters). Koeppe, A. (Technische Hochschule, Stuttgart (West Germany)). Jan. 1967. 28p. (In German). Dep. mn.

Experiments for simulating heat transfer by radiation from the reactor surface to thermionic converters are described. Preliminary investigations on the temperature distribution of heated plates were carried out. In order to get a suitable contact potential difference for the operation of the converter the plates were plated. The operation, as a noble gas converter, with an auxiliary electrode is described. The measured current-voltage-characteristic is discussed. A cesium diode for a SRAST-system was built and is described. (tr-auth)

22089 (BNL-50013) EXPERIMENTAL STUDIES ON HIGH-GRAVITY ROTATING FLUIDIZED BEDS. Lindauer, G. C.; Tichler, P.; Hatch, L. P. (Brookhaven National Lab., Upton, N. Y.). Sept. 1966. Contract AT(30-2)-Gen-16. 38p. Dep. mn. CFSTI $3.00 cy, $0.65 mn.

The behavior of a gas fluidized bed operated under high g's was investigated. The high g's were produced in a rotating vessel which contained the bed in the form of a cylindrical annulus. The bed was bounded on the outside by a porous metal ring which served as a support for the bed and a distributor for the fluidizing gas. The bed particles were glass beads and the fluidizing gas was compressed air at room temperature. Accelerations up to 3450 g's and mass velocities up to 22.7 lb/sec-ft^2 were examined. It was concluded that: it was possible to operate a stable gas fluidized bed at high g's with no bubbling; complete particle mixing in the bed may occur at flow rates substantially below that required for complete fluidization; minimum fluidization data obtained at up to 2210 g's agree well with previous correlations at one g and data obtained at conditions up to 147 g's; substantial bed expansion could be obtained without particle elutriation when the rotating fluidized bed was operated at velocities greater than seven times the flow rate for minimum fluidization of the entire bed; and void fractions for beds settled under high g's were found to vary substantially with the number of g's imposed. (auth)

22090 (NAA-SR-Memo-12139) RADIATOR CONDENSER DESIGN MANUAL. Smith, R. C.; Crosby, J. R.; Elliott, E. A.; Galletly, R. D. (Atomics International, Canoga Park, Calif.). Nov. 1, 1966. Contract AT(11-1)-Gen-8. 173p. Dep. mn. CFSTI $3.00 cy, $0.65 mn.

The design, analytical, and fabrication techniques used in the development of three types of radiator condensers for use on the SNAP II Mercury Rankine Program are presented. The successful testing of each type indicates the appropriateness of the techniques presented. The use of the manual for future radiator designs should aid in achieving an optimum design with a minimum expenditure of effort in the development phase of future programs. (auth)

22091 (SC-DC-67-1414) VORTEX FORMATION AND RESISTANCE IN UNSTEADY FLOW. McNown, John S. (Sandia Corp., Albuquerque, N. Mex. Kansas Univ., Lawrence. School of Engineering and Architecture); Sarpkaya, Turgut (Nebraska Univ., Lincoln). June 1960. Contract AT(29-1)-789. 33p. Dep. mn. CFSTI $3.00 cy, $0.65 mn.

Instantaneous rather than average values of the primary characteristics of resistance in unsteady fluid flow have been obtained from approximate theories combined with studies of numerous laboratory experiments. These have been used to estimate the effect of growing and moving vortices. Further study of these results has led to a fundamental interpretation based on the effects of the formation and shedding of vortices. The vorticity generated in the boundary layer of a cylinder or of a flat plate has been calculated, and the results provide a good check against total vortex strength as computed from experiments. One can then analyze the growth and motion of vortices in the wake, and estimate the forces acting on the cylinder and plate. The forces predicted on the basis of the moving and growing singularities are comparable in magnitude to forces which are observed experimentally. (auth)

22092 (TID-23786) EFFECTS OF ATMOSPHERIC REENTRY ON GRAPHITE PARTICLES. (General Electric Co., Philadelphia, Pa. Missile and Space Div.). Jan. 1964. Contracts AT(40-1)-2847; SNPC-10. 308p. Dep. mn. CFSTI $3.00 cy, $0.65 mn.

A theoretical and experimental investigation was conducted on the oxidation behavior of two materials, ATJ graphite and a reactor material of special interest called Material "X." The oxidation behavior was predicted for both reaction rate controlled and diffusion controlled oxidation for low Reynolds Number (Re) continuum flow and molecular flow, and for the transition on regime between these two flows. Behavior of the reacting surface is described in terms of drag, heat transfer, and mass transfer for these flow conditions which correspond to very high altitudes. Correlation with shock Re was established for both reaction rate and diffusion controlled oxidation. Experimental results agreed with theoretical predictions on the shape change behavior of spherical specimens of the materials. Mass loss data were obtained. Computations determined that all particle sizes investigated would readily survive the selected reentry environments. (L.C.L.)

22093 WHAT IS BOILING? Morin, Rene (EURATOM, Ispra, Italy). Euratom Bull., 5: 109-17(Dec. 1966).

The phenomenon of boiling is described. The differences in evaporation and boiling are pointed out. Vessel and connection boiling are discussed. The well known Nukijama curve for vessel boiling is presented and discussed. The five types of vessel boiling, illustrated on the Nukijama curve, are described. These are natural connection, surface, nucleate, transition, and vapor film boiling. Connection boiling occurs when the fluid circulates in a heated duct e.g., a channel of a boiling water reactor. The following types of connection boiling are described: surface, nucleate, slug flow, annular flow, liquid-deficient region, and superheated steam. (R.C.K.)

22094 POWER DENSITY OF INTEGRAL STEAM GENERATORS FOR HIGH-TEMPERATURE GAS-COOLED REACTORS. Gilli, P. V. (Waagner-Biro AG, Vienna). Neue Tech., 9: 10-17 (Feb. 1967).

The general arrangement of the reactor is largely determined by lay-out and location of the steam generators. The integral concept of a common pressure vessel of prestressed concrete is generally adopted for gas-cooled reactors. Factors influencing the power density in the tube bundle of such steam generator units are investigated, in particular the relations between the gas and the H_2O cycle. Finally, steam generators of future plants with ultrahigh-temperature toppers (gas turbine; MHD generator) are briefly discussed. (auth)

22095 HEAT PIPE. Feldman, K. Thomas Jr. (Univ. of New Mexico, Albuquerque); Whiting, Glen H. Mech. Eng., 89: No. 2, 30-3(Feb. 1967).

The heat pipe, a simple inexpensive device, transports thermal energy at efficiencies greater than 90% and is able to transfer up to 500 times as much heat per unit weight as a solid thermal conductor. There are no moving parts. The heat pipe consists of a closed outer shell, porous wick, and a working fluid. Sufficient working fluid is used to wet the wick. Working fluids are water, acetone, glycerine, ammonia, molten salts, cesium, sodium, potassium, lead, indium, lithium, bismuth, and silver. The outer shell may be glass, ceramic materials, copper, nickel, stainless steels, molybdenum alloys, tantalum, and niobium alloys. Wicks are of woven cloth, fiber glass, porous metals, porous ceramic tubes and narrow screens. The heat pipe can transfer heat from open flame, electric heat, and nuclear heat sources to a thermoelectric or thermionic generator or to a radiator. The heat pipe can serve as a reflux condenser, thermal transformer, or as a power flattener. (F.S.)

22096 HEAT TRANSFER AND PRESSURE DROP MEASUREMENT IN FLOW ACROSS BUNDLES OF SMOOTH TUBES, ESPECIALLY AT HIGH REYNOLDS NUMBERS. Hammeke, K.; Heinecke, E.; Scholz, F. (Kernforschungsanlage, Juelich, Ger.). Int. J. Heat Mass Transfer, 10: 427-46(Apr. 1967). (In German).

In connection with the development of gas-cooled power reactors, measurements of the thermo- and hydrodynamic behaviour of tube bundles, especially at high Reynolds numbers, are required. Only a few tube arrangements have been investigated at Reynolds numbers exceeding 4×10^4. The test facilities, test conditions, and the evaluation procedure of the experimental data are described. Results are given for three bundles of bare tubes which differ only in the tube arrangements, having the same transverse and longitudizal pitches. The three arrangements are parallel-in-line, parallel-staggered, and crossed-in-line. The pitch to diameter ratios were 2.06 and 1.38 for the transverse pitch and the longitudinal pitch, respectively. Data were collected over a Reynolds range from 5×10^3 to 2×10^5 at gas pressures from 1 to 40 atm and at temperatures from 100 to 400°C. The results are in rather good agreement with the data from other authors in the lower Reynolds range, but at Reynolds numbers of about 2×10^5 there is a remarkable rise in the slope of the Nusselt curve, leading to a Reynolds exponent of nearly unity in the case of the parallel-staggered arrangement. The pressure-drop coefficient shows a minimum in the same Reynolds range, then rising again, and seems to become constant for Reynolds numbers exceeding 10^6. This behaviour is less marked in the case of the parallel-in-line bundle. The heat-

transfer data of the crossed-in-line arrangement are the highest, but this is also the case for the pressure drop. (auth)

22097 ANALYSIS OF CRITICAL BOILING IN STEAM GENERATING BOILERS WITH PULSATING CYCLES. Serov, E. P.; Polonskii, V. S. (Moscow Inst. of Power Engineering). Teploenergetika, No. 1, 72-4(Jan. 1967). (In Russian).

The influence of various dynamic factors on critical boiling during forced coolant motion was analyzed. The resolved problem is presented as a structural scheme taking into account the perturbation effect on the consumption, pressure, enthalpy, and heating of the steam. (tr-auth)

22098 TRANSFER OF HEAT TO WATER DURING FORCED FLOW WITHIN THE CRITICAL PRESSURE RANGE UNDER CONDITIONS OF HIGH LOADS ON THE HEATING SURFACE. Moerk-Moerkenstein, P.; Herkenrath, H. (EURATOM, Ispra, Italy). Chem.-Ing.-Tech., 39: 250-3(Mar. 20, 1967). (In German).

In designing reactors, a knowledge of the heat transfer conditions is of great importance, especially at critical loading conditions of the heated surface. The heat transfer numbers have been measured for a pressure and boiling-water circulating system at pressures of 170 to 240 bars, and their dependence on various parameters, such as heat flow density, mass flow and pressure, was investigated. Thus, the heat transfer can be controlled, even at pressures of up to 240 bars, by an appropriate choice of parameters. (tr-auth)

22099 VISUAL AND FRICTIONAL PRESSURE-DROP STUDY OF NATURAL-CIRCULATION SINGLE-COMPONENT TWO-PHASE FLOW AT LOW PRESSURES. Huang, Min-Nan (Univ. of Wisconsin, Madison); El-Wakil, M. M. Nucl. Sci. Eng., 28: 12-19(Apr. 1967).

A visual and frictional pressure-drop study of low-pressure high-void-fraction two-phase flow has been performed in a boiling-water natural-circulation system with heat addition. Heat was added uniformly by four tubular electrical resistance elements placed parallel to the flow, simulating cylindrical nuclear fuel elements. A 6 ft vertical test channel, 1.25 in. ID was used. It contained six opposite pairs of observing windows permitting high-speed motion pictures of the flow to be taken at different operating conditions. Experimental two-phase pressure-drop data at various flow rates were conducted at pressures of 25, 35, and 50 psia, and steam qualities ranging from 0.7 to 7.8% corresponding to void fractions of 63 to 94.5%. Bubbly and transition from bubbly to slug flow regimes were observed. Strong pulsations, inherent in natural-circulation systems with internal heat addition, were also observed. Frictional pressure-drop data were obtained as a function of both quality and mass flow rate. Under the conditions of the investigation, no discontinuities in flow regime or frictional pressure drop were observed and the Martinelli–Nelson correlation for the friction multiplier was found to greatly underestimate the value of the multiplier. (auth)

22100 BOILING HEAT TRANSFER AT THE SURFACE WITH STEAM BUBBLES. Torikai, Kinichi (Japan Atomic Energy Research Inst., Tokyo). Nippon Kikai Gakkai Rombunshu, 32: 1265-74(Aug. 1966). (In Japanese).

Heat transfer was studied at the surface with steam bubbles, using a conductive glass. It was found that a thin liquid film is usually formed between the boiling bubbles and the surface and that the adherence of the bubbles to the surface is somewhat rarer than in the former; the liquid film is thought to be produced by the viscosity of the liquid when the bubbles grow on the surface; and the thin liquid film contributes greatly to good surface heat transfer. Most of the heat transfer takes place in the region of high temperature load. This is probably the reason why the heat transfer is better in the boiling fluid than in the ordinary phase flow. (NSA of Japan)

Isotope Technology

Refer also to abstracts 21900, 21938, and 22211.

22101 (BMwF-FBK-67-02) EXPERIMENTE MIT MASSENSPEKTROMETRISCH GETRENNTEN SPALTPRODUKTSTRAHLEN. (Experiments With Mass Spectroscopically Separated Fission Product Ions). Konecny, E.; Gunther, H.; Siegert, G. (Giessen Univ. (West Germany). Zweites Physikalisches Institut). Jan. 1967. 39p. (In German). Dep. mn.

With a mass spectrometer of the Mattauch–Herzog type at the Munich reactor, fission products can be separated according to mass and energy. The source is a 100 g/cm² U-235 layer in the neutron beam. Using this apparatus investigations were made on: the ionic charge of fission products as a function of kinetic energy and mass; the response of semiconductor surface barrier detectors to fission fragments; the fine structure in the mass yield of the thermal fission of U-235; and the primary nuclear charge distributions for separated masses and their dependence on kinetic energy. (tr-auth)

22102 (BNWL-363) PROMETHIUM ISOTOPIC POWER DATA SHEETS. Fullam, H. T.; Van Tuyl, H. H. (Battelle-Northwest, Richland, Wash. Pacific Northwest Lab.). Feb. 1967. Contract AT(45-1)-1830. 18p. Dep. mn. CFSTI $3.00 cy, $0.65 mn.

Data sheets are presented on the half-life, specific heat generation rate, physical, mechanical, and chemical properties, and shielding requirements of promethium isotopes for use as radioisotopic fuels in space, marine, and terrestrial power applications. (L.C.L.)

22103 (N-67-14931) POWER SYSTEMS RELATED TO OPERATIONS OF A LANDED PLANETARY CAPSULE. Ivanoff, R. G. (Jet Propulsion Lab., Pasadena, Calif.). June 1, 1965. Contract NAS7-100. 83p. (NASA-CR-80991; JPL-TM-33-238). CFSTI $3.00 cy, $0.65 mn.

Power sources that have been proposed for use on space capsules to be landed on the planet Mars are analyzed. The investigation was occasioned by the need to define the advantages and disadvantages of power sources that could provide power for such a landed capsule. The analysis compares the various sources on the basis of weight, operating time, development status, complexity, impact tolerance, and capability to withstand sterilization. Also included is a discussion of the thermal problems that must be considered in the design of radioisotope power systems for this mission. (STAR)

22104 (ORNL-TM-1735) PROGRAM FOR CALCULATING OPTIMUM DIMENSIONS OF ALPHA RADIOISOTOPE CAPSULES EXPOSED TO VARYING STRESS AND TEMPERATURE. Nichols, J. P.; Winkler, D. R. (Oak Ridge National Lab., Tenn.). Apr. 1967. Contract W-7405-eng-26. 82p. (NASA-CR-72172). Dep. mn. CFSTI $3.00 cy, $0.65 mn.

A method and computer program were developed for calculating the creep and optimizing the dimensions of capsules filled with alpha-emitting radioisotopes. The method solves an integral equation that was developed assuming linear accumulation of partial creep lives and relating life to time-dependent stress and temperature using the Larson-Miller parameter. The computer program, CAPSUL, is written in Fortran language for the IBM 360/75 computer. The program makes a least squares fit of the creep life function using conventional constant stress and constant temperature creep data. Dimensions of capsules having maximum thermal power per unit of weight, volume, or area are calculated for a given creep life and pressure-temperature history using a numerical Lagrange Multiplier formulation. The program also calculates the life to a prescribed strain for capsules of given dimensions and pressure-temperature history. The method has been used to analyze creep data for the alloys 304 stainless steel, Hastelloy N, Cb-1% Zr, FS-85, and T-222. (auth)

22105 EXPERIMENTAL STUDY OF TOTAL β ACTIVITY IN THE CASE OF A THICK SOURCE. Voljin, V. (Univ., Bucharest); Ciangiru, Gh.; Postelnicu, C. Rev. Roum. Phys., 11: 705-10(1966). (In French).

An experimental method for the study of the ratio between the activity registered at the detector and the activity in the absence of the interaction of electrons with the substance of the source, is proposed. The approximate percentage of electrons initially released in a direction opposite to that of the detector and rescattered by the source was found. (tr-auth)

22106 USE OF RADIOISOTOPES IN EVALUATING CLEANING OF SURFACES IN CONTACT WITH DAIRY PRODUCTS. Jordan, W. K. (Cornell Univ., Ithaca, N. Y.). Vienna, International Atomic Energy Agency, 1966, Preprint No. SM-75/22, 12p. (CONF-660711-7). ORAU.

From Seminar on the Use of Radioisotopes and Radiation in Dairy Science and Technology, Vienna.

A discussion on the use of radioisotopes as tracers in determining the cleanliness of surfaces in contact with dairy products as compared to direct bacteriological methods is presented. Advantages and disadvantages that are inherent in each method are pointed out. An evaluation of experimental data on cleaning procedures, materials of construction and their surface finishes, and engineering design features is also presented. (B.H.S.)

Materials Testing

Refer also to abstract 22066.

22107 (NVO-193-02) GLASS-REINFORCED PLASTIC CASINGS FOR LARGE DIAMETER HOLES. Final Report, Phase I.

DeHart, Robert C. (Southwest Research Inst., San Antonio, Tex. Dept. of Structural Research). Sept. 14, 1966. Contract AT(26-1)-193. 132p. Dep. mn. CFSTI $3.00 cy, $0.65 mn.

Low cost, filament-wound glass-reinforced plastic casings were developed for large diameter holes 1000 and 5000 feet deep for use in underground nuclear tests. Material properties for the composite used in the casing, which consisted of K diameter E glass and an epoxy resin system, were obtained. (auth)

22108 KRYPTONATES: A NEW TECHNIQUE FOR THE DETECTION OF WEAR. Cucchiara, O.; Goodman, P. (Parametrics, Inc., Waltham, Mass.). Mater. Eval., 25: 109-17 (May 1967).

Use of the kryptonate technique for the study of surface temperatures, chemical reaction rates, and erosion is discussed as it pertains to wear. Kryptonates are solids into which radioactive ^{85}Kr has been introduced in the surface layers to a depth of approximately 10 to 100 mμ. Insofar as is known, the properties of solids are not altered by the introduction of krypton. Following stabilization at an elevated temperature, the kryptonated solids retain their ^{85}Kr content indefinitely unless subjected to external stresses. Such stresses include temperature in excess of the stabilization temperature, chemical reaction at the surface, and mechanical removal of surface layers. Maximum surface temperatures and temperature distributions have been measured by exposing unstabilized samples to unknown environments, and reheating them in a controlled chamber. That temperature at which ^{85}Kr release first commences determines the unknown surface temperature. Since the loss of ^{85}Kr from a sample depends upon the magnitude and duration of the stress, the technique permits measurement of rates of oxidation or other chemical reaction and of mechanical erosion to be measured with extreme sensitivity by determination of the rate of loss of ^{85}Kr activity from the sample. (auth)

22109 NDT APPLIED TO PIPELINE CONSTRUCTION AND OPERATION IN THE U.S.A. Barkow, A. G. (Natural Gas Pipeline Co. of America, Chicago). Mater. Eval., 25: 97-108(May 1967).

Nondestructive testing methods for testing welds in pipelines construction are discussed. These methods include γ- and x-ray radiography using both internal and external sources; ultrasonic inspection; magnetic particle inspection; visual inspection; and hydrostatic yield stress testing. Gamma sources used in radiography include ^{137}Cs, ^{60}Co, ^{192}Ir, ^{228}Th, ^{170}Tm, and ^{175}Yb. Sources used most commonly are ^{60}Co and ^{192}Ir but ^{175}Yb is usually used with thin-walled pipes. Special equipment is discussed including cameras, portable radiographs, programmed γ inspection equipment, and field laboratories. Personnel training is also briefly discussed. (F.S.)

22110 CASK FOR TRANSPORTING IRRADIATED EXPERIMENTAL FUEL ELEMENTS. Schabert, H. P. (Siemens-Schuckertwerke AG, Erlangen, Ger.). Atompraxis, 13: 78-82 (Feb. 1967). (In German).

A dry cask used for transporting irradiated fuel elements having a weight of 4.3 metric tons is described. One experimental fuel assembly producing 0.38 kW of decay heat may be shipped in the cask. The lead shield of the cask remains solid after a 9 meter free drop and a subsequent 1 hour accident fire, due to the use of a special outside insulation which is equipped with metallic straps for decay heat diversion. This design concept should prove advantageous if applied to large fuel casks. (tr-auth)

22111 ALICE B COIL CONSTRAINT FATIGUE TEST SPECIMEN (Engineering Materials). (Univ. of California, Livermore). (CAPE-1569).

2 drawings

The A 286 alloy steel test specimen and fatigue test data are described. The A 286 alloy steel will be used for tie rods and nuts with the 66" baseball magnet in the "Alice" thermonuclear device to replace the BeCu tie rods and nuts which failed. Elongation of the alloy steel is ~32% at -320°F. The tensile yield point is at 110,000 psi while ultimate strength is over 200,000 psi. Magnetic permeability is ~1,003. (For details see TID-4100 Suppl. 40) (F.S.)

Protective Structures

22112 (AD-643019) WINDOW AND WINDOW SCREENS AS MODIFIERS OF THERMAL RADIATION RELEASED IN NUCLEAR DETONATIONS. Progress Report. Bracciaventi, J. (Naval Applied Science Lab., Brooklyn, N. Y. Naval Radiological Defense Lab., San Francisco, Calif.). Dec. 9, 1966. Contract OCD-PS-65-35. 24p. CFSTI $3.00 cy, $0.65 mn.

The number and distribution of ignitions in building interiors due to thermal radiation from nuclear detonation will be a function, in part, of the transmittance of windows and window screens. The spectral transmittance of clean and soiled window glass, and of new and used window screening, was determined in the laboratory. The attenuation as a function of the angle of incidence of the radiation, from 0 degrees to 70 degrees, was determined. Window glass and screens were found to be spectrally neutral in the wave length range 0.34 to 2.70 microns, the spectral band of interest in evaluating the effects of thermal radiation from nuclear detonations. The attenuation caused by soiling as a result of exposure to the atmosphere was minor and did not alter the spectral character of the transmission. The change in attenuation due to varying the angle of incidence was small for angles up to 45 degrees but increased drastically above that. Simple numerical transmission factors are recommended for several situations which cover most window glass-screen combinations to be found in urban areas. (TAB)

Radioactive Material Handling

Refer also to abstracts 22050, 22086, 22110, and 23654.

22113 (BMwF-FBK-65-06) UNTERSUCHUNGEN ZUR STANDORTWAHL EINER VERSUCHSKAVERNE ZUR EINLAGERUNG RADIOAKTIVER RUECKSTAENDE. (Siting Investigations for a Prototype Cavity for Radioactive Waste Storage). Ramdohr, H. (Gesellschaft fuer Kernforschung m.b.H., Karlsruhe (West Germany)). Dec. 1965. 40p. (In German). Dep. mn.

Saline formations in the subsoil of the Federal Republic of Germany offer many possibilities for ultimate storage of radioactive wastes. These types of rock, especially the pure halite-rock, are practically impermeable, have a good thermal conductivity and permit the excavation of large underground rooms at low cost. The storage of radioactive residues is possible either in accessible excavations (as in mines) or in inaccessible rooms (as in storage caverns), which are formed by the solution method. Caverns can be washed out especially in the salt domes of Northern Germany, because these deposits show all necessary criteria (purity, thickness, depth, disposal possibilities for brine). Seven salt domes are investigated and compared both geologically and topographically. It is shown that the deposits of Bunde, Lesum and Harsefeld are good, the deposits Heide and Geesthacht to a limited extent and the deposits of Krummendeich and Leutesheim are not suited for the installation of a disposal cavern. (tr-auth)

22114 (BNWL-365) FIXATION OF RADIOACTIVE RESIDUES. Research and Development Activities Quarterly Progress Report, July-September 1966. Platt, A. M. (ed.) (Battelle-Northwest, Richland, Wash. Pacific Northwest Lab.). Mar. 1967. Contract AT(30-1)-1830. 53p. Dep. mn. CFSTI $3.00 cy, $0.65 mn.

Progress is reported on research and development activities in the field of radioactive wastes. Studies on the addition of zinc phosphates to reduce the tendency for rare earth phosphates to separate from melts were made. The use of reducing atmospheres (e.g., NH_3) rather than air reduced or eliminated separate melt phases in borophosphate and silicate melts. Corrosion rates of 310 SS in ORNL Rising Level Glass-type melts were generally lower than 304-L SS however, in a few instances accelerated attack on 310 occurred. Preparations were being made for leach testing of Waste Solidification Engineering Prototype (WSEP) products. Leach rates of simulated products were measured for comparison purposes. Effective thermal conductivity of continuous spray solidifier solid in pots was determined to be 0.9 W/sq m °C/m (1.6 Btu/hr × ft² × °F/ft). Differential thermal expansion measurements confirmed acceptable yield values for the container wall as long as repetitive cycling of temperatures is avoided. Measurements of pot wall thickness by ultrasonics detected corroded areas within ±0.010 in. of the actual wall thickness. Failure of a platinum-0.5% rhodium melter on the Spray Solidifier of WSEP after 440 hr of service has initiated investigation of the cause. A Rising Level Glass experiment in WSEP was terminated by corrosion failure of the pot. Equipment functions of WSEP were good. Testing of the continuous phosphate glass equipment was continued by completing a design verification test run. Tolerable feed composition changes were defined and the feasibility of filling a large (12 in. OD) mild steel pot was demonstrated. No stalagmite formation occurred at low flow rates into the pot. The dissolution rate of sodium sulfate melts was determined. Results indicate that sodium sulfate melts prepared from glass melter condensate would dissolve at a rate sufficient to release 10^2 to 10^4 times as much radionuclides as a phosphate glass would under the same leaching conditions. Carbon was effective for reducing sulfuric acid in the glass melter condensate to sulfur dioxide. A two-step scavenging procedure for treating glass melter condensates was developed. Phosphotungstate precipitation and mixed

hydrous oxide scavenging were the two steps employed. This method removes 98.8% ^{144}Ce, 76.6% ^{106}Ru, 99.2% ^{137}Cs, 97.0% ^{95}Zr, and 98.0% ^{89}Sr. The effluent from this process can be stored in asphalt. Cesium-137 was found to be the prominent isotope released from melts at temperatures from 1100 to 1200°C, confirming earlier results. Release rates ranged from about 1×10^{-3} to 3×10^{-2}/hr. Ruthenium-106 was released nonreproducibly and the release ranged from virtually zero to about 1 to 2×10^{-2}/hr. Strontium-90 and ^{144}Ce were released at rates about $^{1}/_{1000}$ of those of ^{137}Cs. Studies of release rates were terminated. (auth)

22115 (K-1714) PROTECTIVE SHIPPING PACKAGES FOR 8- AND 12-INCH DIAMETER UF_6 CYLINDERS. Mallett, A. J.; Newlon, C. E. (Oak Ridge Gaseous Diffusion Plant, Tenn.). Apr. 20, 1967. Contract W-7405-eng-26. 37p. Dep. mn. CFSTI $3.00 cy, $0.65 mn.

The design and development of protective shipping packages for 8- and 12-in.-dia uranium hexafluoride cylinders are described. A reinforced high-temperature phenolic foam plastic developed at the Oak Ridge Gaseous Diffusion Plant is used as a structural support and fire-resistant insulation lining. The packages, which are also considered applicable for shipment of other fissionable material containers, have received both AEC and ICC approval for Class II shipment of these cylinders. (auth)

22116 (KY-521) DESIGN AND FABRICATION OF A PROTOTYPE LAMINATED URANIUM METAL SHIPPING CASK FOR LARGE SHIPMENTS OF ^{60}Co. Clifford, C. B. (Paducah Gaseous Diffusion Plant, Ky.). Apr. 3, 1967. Contract W-7405-eng-26. 38p. Dep. mn. CFSTI $3.00 cy, $0.65 mn.

The design standards, engineering drawings and the manufacturing techniques used in fabricating a prototype laminated depleted uranium metal shipping cask for transporting 150,000-curie lots of cobalt-60 are presented. The cask design was based on criteria furnished by the Oak Ridge National Laboratory and the latest drafts of the proposed 10 CFR 71 regulations and Chapter AEC-0529. Emphasis was placed on reducing the weight and volume of the cask in order to minimize the problems associated with transporting and handling the cask in the cells located at ORNL and their customer's facilities. Heat transfer test data are presented to show the temperatures obtained by dissipating up to 1.8 times the design heat load of electrical energy inside the cask. (auth)

22117 (ORNL-4035) COMPREHENSIVE REPORT OF THE CLINCH RIVER STUDY. Struxness, E. G.; Carrigan, P. H. Jr.; Churchill, M. A.; Cowser, K. E.; Morton, R. J.; Nelson, D. J.; Parker, F. L. (Oak Ridge National Lab., Tenn.). Apr. 1967. Contract W-7405-eng-26. 126p. Dep. mn. CFSTI $3.00 cy, $0.65 mn.

A study of the chemical, physical, and biological dynamics of the Clinch and Tennessee River systems was conducted over a period of 5 years from 1960 to 1964. The safety of disposal operations, during which low-activity wastes from ORNL were discharged into the Clinch River via White Oak Creek from 1944 to 1959, were evaluated. Several federal agencies participated in the study which involved hydrologic measurements, sampling and analysis of river water, bottom sediment and fish, a systems analysis (mass balance), and radiation safety analysis. The most important radioisotopes studied were ^{60}Co, ^{90}Sr, ^{106}Ru, and ^{137}Cs. Cobalt-60, ^{90}Sr, and ^{106}Ru in the waters of the river system were either in solution or retained by very fine suspended particles. By contrast, ^{137}Cs was associated with the large size suspended particles (sediment) in White Oak Creek and Clinch River, but mainly in solution or in fine particle suspension in the Tennessee River. 1.5% of the total radioactivity released from White Oak Creek to the Clinch since 1944 accumulated in the bottom sediment. Radiation hazards to humans by contamination from drinking water, eating fish, or recreational uses of the rivers was calculated as one-tenth the maximum permissible dose. Continued monitoring of the river system is recommended. (L.C.L.)

22118 HIGH LEVEL RADIOACTIVE SOLID WASTE BURIAL OPERATIONS FOR THE EBR-II FUEL CYCLE FACILITY. Holcomb, W. F.; Paige, D. M.; Stevenson, C. E.; Graham, E. D. (Argonne National Lab., Idaho Falls, Idaho). Nucl. Eng. Design, 5: 221-7(Mar. 1967).

The Fuel Cycle Facility of the EBR-II complex generates high level, non-combustible radioactive solid waste from the reprocessing and refabricating of reactor fuel. The burial facility permits the long-range burial with retrieval as opposed to permanent burial of high-level solid wastes. The burial site utilizes post-hole burial with high integrity steel liners. A top-loading, bottom-dumping waste handling coffin and special lowboy trailer were built for use at this facility. Four sizes of waste containers are used with all operations being done entirely by remote control. The first one hundred burials contained an estimated 6600 kg of waste material with an estimated 1.6×10^{6} curies of activity and radiation levels as high as 9×10^{3} R/hr. (auth)

22119 HIGH-LEVEL RADIOACTIVE WASTE. Carleson, G. (Aktiebolaget Atomenergi, Stockholm). Svensk Kem. Tidskr., 79: 136-41(1967). (In Swedish).

Research and development achieved at the Swedish Atomic Energy Company on handling, separation, concentration, and ultimate disposal of medium- and high-activity wastes obtained at research centers, nuclear reactor sites and reprocessing plants is described. Most of the development activities were directed towards methods for waste concentration by ion exchange and freezing techniques. (INIS-SWEDEN)

22120 RADIOACTIVE LIQUID WASTE DECONTAMINATION TESTS WITH A PACKED-TYPE EVAPORATING TOWER. Kadoya, Shozo; Matsumura, Takio (Ebara Mfg. Co., Ltd., Japan). FAPIG (Tokyo), No. 40, 31-3(Apr. 1966). (In Japanese).

With a packed-type evaporating tower of specified design, the decontamination of radioactive liquid wastes was analytically studied, especially the reflux effect. In the evaporation–condensation procedure for treatment of radioactive liquid wastes, the decontamination factor depends largely on the treatment of entrained vapor mist. An evaporating tower was constructed in which a Raschig-ring packed tower was employed as the mist trapping device, with the condensate flowing back from the top of the evaporation tower. With this apparatus, the relationship of the decontamination factor, and the evaporation rate, the reflux ratio, and the theoretical number of process stages were studied. The applicability of such a system for the treatment of high-level liquid wastes was investigated, and it was found that two separate sections of recovery and condensation could be effectively introduced, and that this fact could be designed into the actual system. (NSA of Japan)

Vacuum Engineering

22121 MEASUREMENT OF PRESSURE IN HIGH AND ULTRAHIGH VACUUM REGIONS USING IONIZATION GAGES: PART II. COLD CATHODE GAGES. Sharma, S. K. (National Physical Lab., New Delhi). J. Sci. Ind. Res., 25: 535-8(Dec. 1966).

Techniques used in the measurement of high and ultrahigh vacuum using cold cathode gages are reviewed. The principles involved in the construction and operation of various types of cold cathode gages, i.e., magnetron gages, ionization gages, scintillation gages, photomultiplier ionization gages, and the cold cathode orbitron gage are described and their limitations indicated. A comparison of the relative performance of hot and cold cathode gages is made. It is concluded that substantial improvements in the design and fabrication of cold cathode gages are necessary before they can be used to measure the same lower limits of pressure as hot cathode gages. (R.C.K.)

22122 IONIC TRAPPING OF HELIUM IN CLEAN AND CONTAMINATED GLASS. Grant, W. A.; Carter, G. (Univ. of Liverpool). Vacuum, 16: 485-6(1966).

The ionic trapping mechanism for He and the subsequent movement and release of this gas were studied using an electron bombardment technique. The Pyrex glass surface under bombardment was the inside wall of a diode in which ions were formed by electron impact and accelerated towards the glass walls. The diode was included in an ultrahigh vacuum system in which background pressures less than 10^{-9} torr could be achieved. Preliminary results are also reported for the trapping efficiency of the inert gases Ne, Ar, Kr, and Xe. For Ar, Kr, and Xe the values rose rapidly from 0.1 at 25 eV towards 0.9 at 250 eV, while for Ne the trapping efficiency changed only slightly over this energy interval and stayed in the range 0.1 to 0.2. The ionic pumping of He was shown to occur at a glass surface only if a metal contaminant layer is present. Desorption transients for the release of He from W-contaminated Pyrex glass surfaces are presented and analyzed on the basis of one-step desorption from sites with a single activation energy. A comparison was made with previous work on glass using the other inert gases and with experiments conducted with unequivocally W surfaces. The variation of desorption of He with temperature was quite different from the results obtained in the same series of experiments with the other inert gases. For Ne, Ar, Kr, and Xe the desorption transients were of a similar shape to that for He but much broader, extending from room temperature up to 500°C. (BBB)

22123 INITIAL ION-ENERGY DISTRIBUTION AND THE MEASUREMENT OF VERY LOW PRESSURE I. Comsa, George (Inst. of Nuclear Physics, Bucharest). Rev. Roum. Phys., 11: 901-9(1966).

The present state of information concerning the ion-energy distribution at the moment of ion production is presented. The

influence of the initial velocities of the two ion types, thermal and energetic, on their collection in a Bayard–Alpert gage is calculated. Since thermal ions have a Maxwell energy distribution, it is shown that, in usual working conditions, a great part of ions is not collected. The collection of energetic ions will be even more defective. Starting from these considerations, several known phenomena are explained and attention is called to possible error sources in measurements with Bayard–Alpert gages. It is also shown that in the omegatron, the initial velocities of energetic ions cause measurement disturbances. The theoretical arguments as well as the performed experiments permit an evaluation of the sensitivity of the Bayard–Alpert gage for the initial ion velocities which make it useful for investigations that imply a particular fineness such as: obtaining information on the nature of the energy distribution of gas molecules in high and ultrahigh vacuum and the detection of momentum transfer in ionizing collisions. (tr-auth)

22124 METHOD FOR THE MANUFACTURE OF VACUUM CONTAINERS. Petermann, Lucien (to CEA). British Patent 1,066,134. Apr. 19, 1967. Priority date May 12, 1964, France.

A method is described for manufacturing vacuum containers which are used in attaining an ultimate vacuum of the order of 10^{-10} torr. The method consists of machining and shaping the container walls; a cleaning operation; a polishing operation carried out either by an electrolytic process, chemical process, or mechanical process; a rinsing operation; and a surface treatment of the walls by oxidation carried out at 430 and 550°C followed by heating at 200 to 300°C. Nitriding, carbiding, or hydriding processes may also be used for surface treatment. (F.S.)

INSTRUMENTATION

Radiation Detection Instruments

Refer also to abstracts 22488, 22519, 22771, 23036, 23288, and 23447.

22125 (AERE-M-1832) THE APPLICATION OF THE HARWELL 2000 SERIES ADAPTOR UNITS TO THE DETECTION AND MEASUREMENT OF RADIOACTIVITY. Snelling, G. F. (Atomic Energy Research Establishment, Harwell (England)). Feb. 1967. 32p. Dep. mn. CFSTI $3.00 cy, $0.65 mn. HMSO 4s.

A range of adaptor units is described, each capable of being coupled directly to the appropriate type of detector, and yielding analogue output pulses of up to 5 volts amplitude. Proportional counters, semiconductor detectors and scintillation counters are provided for; a fourth adaptor, for use with NaI scintillation counters, provides stabilization against both temporal drift and drift due to detector temperature variations. Some simple counting systems based upon these adaptors are described, and experimental data given. (auth)

22126 (CERN-66-36) DETECTORS FOR AUTOMATIC FILM STOP DEVICES. Durupthy, G.; List, H.; Sharp, J. (European Organization for Nuclear Research, Geneva (Switzerland)). Dec. 23, 1966. 38p. Dep. mn.

The problems of frame location in processing photographic film from bubble and spark chambers and some solutions developed for this purpose are discussed. Specifications for location information marks (the so-called Brenner marks) are included. An experiment which may form the basis for future frame marking is described. (B.G.D.)

22127 (FOA-04-4288-21) FAST TIME-OF-FLIGHT SPECTROMETER. Beckman, L.; Hansen, J.; Jansson, R. (Forsvarets Forskningsanstalt, Stockholm (Sweden)). Feb. 1967. 22p. Dep.

A fast time-of-flight spectrometer is developed. The basic components are a bunched van de Graaff accelerator and a set fast scintillation detectors. Electronic circuitry essential for the time resolution is described. Measurements of the time resolution of the spectrometer using gamma radiation is found to be 1.1 ns (fwhm). The corresponding energy spread in the proton beam was calculated to ±0.4 percent at 1.9 MeV. (auth)

22128 (LA-DC-8634) HIGH TEMPERATURE NEUTRON DETECTOR TEST. Swickard, Earl O.; Bacastow, Jack L. (Los Alamos Scientific Lab., N. Mex.). [nd]. Contract W-7405-eng-36. 18p. (CONF-670314-2). Dep. CFSTI.

From Liquid Metal Instrumentation and Control Symposium, Idaho Falls, Idaho.

The testing of two high temperature neutron detectors from each of three manufacturers has been started. Three parameters are varied during tests: source (none, neutron), chamber voltage (mfr's recommended, high, low), and temperature (100°C increments to 600°C). At each temperature, measurement of detector (and integral lead) resistance and capacitance is made. Testing is presently at the 200°C temperature. (auth)

22129 (N-67-15251) GRAPHIC SUMMARY OF THE RESPONSES OF THE UNIVERSITY OF IOWA CHARGED PARTICLE DETECTORS ON EXPLORER 14. Frank, L. A.; Bohlin, R. C.; McClain, I. L. (Iowa Univ., Iowa City. Dept. of Physics and Astronomy). Sept. 1966. 403p. (NASA-CR-81141). CFSTI $3.00 cy, $0.65 mn.

Graphs of the responses of the charged particle detectors borne on Explorer 14 are displayed for the period extending from launch on 2 October 1962 through 9 August 1963 when transmission of data terminated. This graphic summary provides a convenient abridged dictionary of available data and serves as a useful guide for further processing of these data. (auth)

22130 (NYO-2171-221) A FULLY AUTOMATIC HPD SYSTEM FOR SPARK CHAMBER PICTURES. van Dyck, Olin B. (Pennsylvania Univ., Philadelphia). Jan. 18, 1967. Contract AT(30-1)-2171. 25p. (CONF-670105-5). Dep. mn. CFSTI $3.00 cy, $0.65 mn.

From International Conference on Flying Spot Devices, Munich, Germany.

A description is presented for a fully automatic HPD system for spark chamber pictures. The topics considered include the experiment analyzed, the University of Pennsylvania HPD, the analysis program, and the program performance. (J.F.P.)

22131 (NYO-2171-222) AUTOMATIC TRACK FOLLOWING PROGRAM AT THE UNIVERSITY OF PENNSYLVANIA. Bogart, E.; Brody, H.; Brooks, S.; Churchill, W.; Hagopian, S.; Selove, W. (Pennsylvania Univ., Philadelphia). Jan. 18, 1967. Contract AT(30-1)-2171. 15p. (CONF-670105-4). Dep. mn. CFSTI $3.00 cy, $0.65 mn.

From International Conference on Flying Spot Devices, Munich, Germany.

Characteristics of an automatic system for processing bubble chamber pictures using the HPD are presented: the data processing ing scheme is for the $\pi^- + P$ interaction, the system is an off-line system of production, the programming is written completely in FORTRAN (except for trivial 1−O and packing routines), prescanning of the film is possible, and pictures are only taken when an event occurs. (B.G.D.)

22132 (ORNL-TM-1767) DESCRIPTION OF FACILITY RADIATION AND CONTAMINATION ALARM SYSTEMS INSTALLED IN THE CHEMICAL TECHNOLOGY ALPHA LABORATORY, BLDG. 3508. Russell, J. A. Jr.; Knowles, D. J. (Oak Ridge National Lab., Tenn.). Mar. 10, 1967. Contract W-7405-eng-26. 21p. Dep. mn. CFSTI $3.00 cy, $0.65 mn.

Facility radiation and contamination alarm systems were installed in the Chemical Technology Alpha Laboratory to continuously and automatically monitor neutron radiation (by three neutron rate-burst detectors) and air contamination (by five constant alpha air monitors) in the entire facility. These instruments and other components in the network provide health physics monitoring information, sound local alarms when abnormal conditions occur, and indicate the abnormal conditions on a central panel board. Operating personnel are first given warning when a high level is detected by a constant alpha air monitor. The neutron detectors operate rate or burst alarms when the alarm levels are exceeded. The building evacuation system operates automatically when two or more constant alpha air monitors detect a high level of air contamination or when two or more neutron monitors detect a neutron burst or a high-rate level. (auth)

22133 (SLAC-72) TEUTA: KINEMATICAL ANALYSIS PROGRAM FOR COLLIDING BEAM EVENTS. Derado, I.; Leedy, R. (Stanford Linear Accelerator Center, Calif.). Feb. 1967. Contract AT(04-3)-515. 30p. Dep. mn. CFSTI $3.00 cy, $0.65 mn.

TEUTA is a FORTRAN IV program that does kinematical analysis of events with correlated momenta, such as events without a visible vertex. Incoming, outgoing, and target particles are all treated as four-component vectors (m_i, $1/p_i$, λ_i, φ_i) thus allowing TEUTA to be used for colliding beam, unknown target particle, and disintegrating particle experiments with no program changes. TEUTA is written in subroutine form where everything is kept as simple as possible so that the user need supply only the peripheral routines necessary to blend TEUTA into his system. The additional peripheral programs described were developed at SLAC for streamer chamber data analysis. To use TEUTA one must first supply data describing an event in the form of two adjoint four-vector arrays, P_i^m and I_i, and full correlation error matrix, G_{ij}. The P_i^m array contains m_i, $1/p_i$, λ_i, φ_i, and the I_i array contains integers that tell if the P_i^m data is fixed, measured, or unknown. Then one may supply any number hypotheses consisting of lists of fixed masses preceded by plus or minus signs to depict incoming and outgoing particles. TEUTA calculates new "best values," P_i^t, such that energy and momentum are conserved and the expression $(P_i^m - P_i^t)\, G_{ij}^{-1} (P_j^m - P_j^t)$ is minimized. (auth)

22134 (UCID-15128) PROPORTIONAL COUNTER GAS SYSTEM REGULATOR FOR X-RAY ASTRONOMY. Harri, John (California Univ., Livermore. Lawrence Radiation Lab.). Apr. 7, 1967. Contract W-7405-eng-48. 9p. Dep. mn. CFSTI $3.00 cy, $0.65 mn.

The thin window proportional counters which are currently being flown for x-ray astronomy measurements in LRL diagnostic payloads are heavily dependent on a gas system to precisely maintain a fixed argon (P-10) pressure in the counter. This gas system must permit the flushing of contaminated gas from the counter and must replace gas which leaks through saran-polyethylene counter windows. Some of the regulation problems encountered and a regulator which was developed to satisfy the needs are described. (B.G.D.)

22135 MEASUREMENT OF THERMOEMISSION BY MEANS OF GEIGER-MUELLER COUNTERS. Ettinger, K. W.; Moscicki, W. (Technical Univ., Danzig). Acta Phys. Pol., 31: 715-19 (Apr. 1967).

The wire-form thermoelectron emitters made of Cu, Fe, Mo and W were investigated by means of GM-counters. The emitters were introduced into the sensitive region of the counter, parallel to the anode wire. (auth)

22136 USE OF MAGNETIC FOCUSING IN PRECISION FLIGHT-TIME SPECTROMETERS FOR HEAVY CHARGED PARTICLES. Belostotskii, S. L.; Vorob'ev, A. A.; Seliverstov, D. M. Izv. Akad. Nauk SSSR, Ser. Fiz., 30: 167-74(Jan. 1966). (In Russian).

The matrix technique of M. Birk, A. Kerns, and R. Tusting (IEEE Trans., NS-11, 3, 129 (1964)) and A. Sternglass (IEEE Trans., NS-11, 3, 87 (1964)) was used to calculate the characteristics of a flight-time spectrometer employing a double focusing triplet quadrupole magnetic lens. The use of focusing in a flight-time spectrometer greatly increases the solid angle of acceptance but reduces the resolving power, since the focused ions can reach the detector by different paths. The calculations were performed for a specific spectrometer having an 11.4 meter base and the calculated characteristics are compared with experimental values. With an 11.4 meter base and a quadrupole triplet with an aperture of 16 cm it is possible to achieve an energy resolution of 0.015% with an acceptance angle of $6 \times 10^{-5}/4\pi$ sterad. By simultaneously increasing the base length and the lens aperture it is possible to increase the resolution while keeping the acceptance angle constant. With a photomultiplier having a resolving time of $2\text{-}3 \times 10^{-10}$ sec as detector and an 11 m base the instrumental half-width of a 5 MeV α-particle line is 3-4 keV, and that of a 5-MeV proton line is 6-8 keV. It is concluded that focused flight-time spectrometers can be usefully employed for precision measurements, particularly with low-energy heavy particles. (ATD)

22137 WHOLE-BODY COUNTERS: APPLICATIONS AND POTENTIAL IN ANIMAL SCIENCE AND VETERINARY MEDICAL RESEARCH. Twardock, A. R. (Univ. of Illinois, Urbana); Lohman, T. G.; Breidenstein, B. C.; Smith, G. S. Ill. Vet., 8: No. 1, 3-4; 6(Winter 1965). (COO-1339-5).

The Illinois Animal Science Counter (ILLASCO) is described. Research applications of ILLASCO include studies of body composition in beef cattle and sheep with emphasis on ^{40}K levels, and investigations of metabolism of fallout nuclides in beef cattle. (H.G.D.)

22138 SYMPOSIUM ON ATOMIC ENERGY IN ANIMAL SCIENCE. I. THE ILLINOIS ANIMAL SCIENCE COUNTER: PERFORMANCE CHARACTERISTICS AND ANIMAL RADIOACTIVITY MEASUREMENT PROCEDURES. Twardock, A. R.; Lohman, T. G.; Smith, G. S.; Breidenstein, B. C. (Univ. of Illinois, Urbana). Contract AT(11-1)-1339. J. Anim. Sci., 25: 1209-17 (Nov. 1966). (COO-1339-1; CONF-640820-1).

A large-volume liquid scintillation detector capable of measuring radioactivity in human beings and animals as large as cattle is described. The performance characteristics of the instrument are described, including short- and long-term electronic stability, energy resolution, detection efficiency calibration, and the use of instrument standards. Methods are discussed for preparing animals for ^{40}K measurements so as to reduce interference by radiocontaminants, and for loading and positioning animals in the detector so as to minimize errors caused by positioning and subject movement. (auth)

22139 PERFORMANCE OF Ge(Li) DETECTORS IN THE TEMPERATURE RANGE 5.0 TO 170°K. Sakai, E.; Malm, H. L. (Atomic Energy of Canada Ltd., Chalk River, Ont.). Appl. Phys. Lett., 10: 268-70(May 15, 1967).

The properties of three Ge(Li) detectors as γ-ray spectrometers were measured over the temperature range 5.0 to 170°K. These detectors, selected to show a range of charge-trapping effects, all exhibited predominantly electron trapping, and optimum resolution occurred between 20 and 30°K where electron-trapping effects were a minimum. As the temperature was reduced it was possible to increase the operating voltage, giving some improvement in resolution. Below 20°K the γ-ray resolution rapidly deteriorated due to the appearance of a slow-rising component (up to 20 μsec) in the preamplifier pulses. (auth)

22140 FORTRAN IV PROGRAM FOR AUTOMATIC EXTERNAL STANDARDIZATION IN LIQUID SCINTILLATION SPECTROMETRY. Spratt, J. L.; Lage, G. L. (Univ. of Iowa, Iowa City). Int. J. Appl. Radiat. Isotop., 18: 247-52(Apr. 1967).

The FORTRAN IV computer program referred to as AUTDPM and described in (Int. J. Appl. Rad. Isotopes 16, 439(1965)) was extensively modified and extended to incorporate the automatic computation of quench correction using automatic external standardization. This allows for the accumulation of data in the final disintegrations per minute form without the additional sample handling and second counting necessitated by the internal standard technique. The samples are not contaminated with an internal standard radioisotope and may be re-claimed for further use. The new program (AUTAES) will still perform all the functions of the AUTDPM program except that it is limited to a total of 5 counting cycles rather than 10 cycles per group of samples. (auth)

22141 MULTICRYSTAL SCANNER IS RAPID AND VERSATILE. Hindel, Robert (Intertech, Inc., North Haven, Conn.); Gilson, Albert J. Nucleonics, 25: No. 3, 52-7(Mar. 1967).

A multicrystal scanner (Dynapix) that consists of 10 parellel sodium iodide crystals coupled by light pipes to 10 photomultipliers; a control console housing all electronics and providing a convenient operating base for both live monitoring and magnetic tape storage and the scanner mechanics is described. Operation and clinical applications of the scintiscanner are also discussed. (B.G.D.)

22142 RESPONSE OF LONG COUNTERS AS A FUNCTION OF NEUTRON ENERGY. Robaye, G. (Univ., Liege). Bull. Soc. Roy. Sci. Liege, 35: 637-45(1966). (In French).

The results of a calculation simulating the operation of a long counter are given. The relative efficiency calculated as a function of the energy of the incident neutrons and of the point of impact is given. It is shown that it is impossible to obtain a flat response over a large energy range by a single choice of optimum moderator geometry. A complementary method of approach is outlined. (tr-auth)

22143 MEASUREMENT OF THE IRRADIATION PRO UNIT OF TIME, USING IONIZATION CHAMBERS WITH VIBRATORY CONDENSER. Voedroes, Daniel; Viragh, Elemer. Magyar Radiol., 18: 357-60(Dec. 1966). (In Hungarian).

The ionization currents produced by different gamma-radiating isotopes in ionization chambers have been measured by means of an electrometer with a vibratory condenser. Using ionization chambers with volume of 1, 10, 100, 2500 and 10,000 cm^3 and with resistance of 10^9, 10^{10} and 10^{11} ohms, the intensity of the doses used in the radiological practice may be determined with great accuracy. (auth)

22144 COMPTON SEMICONDUCTOR GAMMA SPECTROMETER WITH IMPROVED SENSITIVITY. Melent'ev, V. I.; Ovechkin, V. V.; Rudenko, V. S. Prib. Tekh. Eksp., No. 1, 45-9(Jan.-Feb. 1967). (In Russian).

The parameters of the Compton γ spectrometer with semiconductor detectors without collimation of the primary beam of γ quanta were investigated. The energy resolution of the spectrometer at 447 keV (^{137}Cs) is 4.2%; the complete output is 1.5×10^{-5} which satisfactorily agrees with the calculated values and is approximately three orders of magnitude greater than that of the Compton spectrometer with collimation. (tr-auth)

22145 STABILIZATION OF THE AMPLIFICATION OF THE GAMMA SPECTROMETER DURING UTILIZATION OF MULTICHANNEL ANALYZER. Burmistrov, V. R.; Asil'bekov, B. (Inst. of Nuclear Physics, Alma-Ata, USSR). Prib. Tekh. Eksp., No. 1, 49-53(Jan.-Feb. 1967). (In Russian).

The stabilization system of the scintillation spectrometer was investigated by differences of the counting speed in the channels of the peak of the actuating spectra and controlling all amplification circuits of the spectrometer from the scintillator to the analyzer inclusively. A comparison of the experimental results was made with the results obtained from the investigation of the stabilization system with supplementary one-channel differential analyzer. For measurements with FEU-24 during the course of 30 hours and with change of the priming by ten times and with oscillation of the medium temperature from 18 to 36°C the use of the stabilization system studied improved the stability of the spectrometer at least 30 times and the maximum deflection from the mean plane was increased no more than ±0.5%. (tr-auth)

22146 EVALUATION OF THE DISPERSION OF THE TOTAL NUMBER OF SPARKS, ACCOMPANYING THE EVOLUTION OF THE ELECTRON-PHOTON SHOWER IN MULTILAYER SPARK CHAMBERS. Govorkov, A. B.; Govorkov, B. B. (Lebedev Inst. of Physics, Moscow). Prib. Tekh. Eksp., No. 1, 54-7 (Jan.-Feb. 1967). (In Russian).

A simple model of the statistical behavior of particles in electron-photon cascades was proposed. This model makes possible the evaluation of the complete number of particles in the shower and their dispersion as a function of the energy of the primary electrons and of the material and thickness of the layers of the spark chamber. The dependences obtained on the basis of the model agree with the experimental data on the spectral properties of multilayer spark chambers. The possibility was indicated of the existence of a limit in the energy resolution by a decrease in the thickness of the chamber layer, connected with the branching character of the process of particle multiplication in the cascade. For thicknesses of one radiation unit length the experimental data confirmed the similarity of the statistics of the shower particles to the Poisson statistics. (tr-auth)

22147 SYSTEM OF PHOTOGRAPHY FOR THE METRIC BUBBLE CHAMBER. Budagov, Yu. A.; Bychkov, V. A.; Volod'-

ko, A. G.; (and others) (Joint Inst. for Nuclear Research, Dubna, USSR). Prib. Tekh. Eksp., No. 1, 61-6(Jan.-Feb. 1967). (In Russian).

The construction of a six-lens stereophoto apparatus for the JINR bubble chamber and the series of questions solved during its construction were examined. The results of the experimental study of the accuracy of a reconstruction of the spatial chart of events in the working volume of the chamber are also presented. (tr-auth)

22148 WIRE SPARK CHAMBER WITH EXTERNAL ACOUSTICAL TRANSMITTING ELEMENT. Ambro, P.; Karzhavin, Yu. A.; Matyushin, V. T.; Matyushin, A. T.; Shoshev, P. (Joint Inst. for Nuclear Research, Dubna, USSR). Prib. Tekh. Eksp., No. 1, 66-8(Jan.-Feb. 1967). (In Russian).

A wire filmless chamber in which the Cartesian coordinates of the spark were registered with an external acoustical transmitting element was described. The chamber makes it possible to register simultaneously some sparks arising in the discharge gap. (tr-auth)

22149 TEST OF THE UTILIZATION OF DILUTE EMULSIONS WITH REDUCED SHRINKAGE COEFFICIENT. Kirillova, L. F.; Lonina, N. A.; Sviridov, V. A.; Khristov, L. G.; Shafranova, M. G. (Joint Inst. for Nuclear Research, Dubna, USSR). Prib. Tekh. Eksp., No. 1, 72-3(Jan.-Feb. 1967). (In Russian).

Some properties of dilute emulsions of NIKFI manufacture and the method for the reduction of its shrinkage coefficient by a value of 0.7 were described. The utilization of emulsions with reduced shrinkage coefficient proved useful in tests on the study of the angular p-p and p-d scattering at high energy. (tr-auth)

22150 DEPENDENCE OF THE CHARACTERISTICS OF THE SCINTILLATION COUNTER WITH FEU-66 ON THE TEMPERATURE. Vedekhin, A. F.; Golotkov, E. T.; Gribanova, V. M.; Pavlov, Yu. P. Prib. Tekh. Eksp., No. 1, 75-7(Jan.-Feb. 1967). (In Russian).

The coefficients of the change of the signal output δ of the counter with a FEU-66 photomultiplier with crystals of the type NaI(Tl) and CsI(Tl) and with slow neutron detectors of the LDNM-P-3 type using luminescent compound ZnS(Ag) + $^{10}B_2O_3$ were experimentally determined. The data showed that for NaI(Tl) crystals at all temperature intervals $\delta_1 = -0.3 \pm 0.001\%/°C$. In the case of CsI(Tl) crystals the pulse amplitude at t = 70 to 80°C is increased with $\delta_1 = +0.18 \pm 0.01\%/°C$, and then is decreased with $\delta_1 = -1.0 \pm 0.05\%/°C$. During measurements with LDNM-P-3 detectors the pulse amplitude remains steady with temperature changes from 18 to 120°C and $\delta_1 = 0$. The counter resolution with NaI(Tl) crystals at t = 60°C changes with the coefficient $\delta_2 = +0.1\%/°C$, and in the temperature interval from 60 to 80°C $\delta_2 = 0.3\%/°C$, and at t = 85 to 130°C $\delta_2 = 0.63\%/°C$. As the coefficients of the change of the light yield of the scintillators NaI(Tl), CsI(Tl), and ZnS(Ag) are equal to −0.12, −1.0, and 0%/°C respectively, it was assumed that in the temperature range from 18 to 120°C the integral sensitivity of the FEU-66 in the region of the NaI(Tl) radiation is decreased with the coefficient $\delta_3 = -0.18\%/°C$, in the region of the ZnS(Ag) radiation it does not change, and in the wave length interval for CsI(Tl) radiation it increases from 70 to 80°C with $\delta_3 = +1.18\%/°C$, and at t > 70 to 80°C it remains stable. (tr-auth)

22151 LIQUID WATER–OXANE SCINTILLATORS. Zhil'tsova, L. Ya.; Matveeva, E. N.; Medvedev, M. N. (Joint Inst. for Nuclear Research, Dubna, USSR). Prib. Tekh. Eksp., No. 1, 79-81(Jan.-Feb. 1967). (In Russian).

The results of the measurement of the pulse amplitude and the duration of the light spark from liquid water–dioxane scintillators in dependence on the concentration of the scintillating substance and of water were reported. The scintillators, containing 8g/l of 2,5-diphenyloxazole + 50 g/l of naphthalene or 20 g/l of 2-phenyl-5(4-biphenyl) 1,3,4-oxadiazole + 50 g/l naphthalene in the dioxane, mixed with water, do not lose their scintillation properties at water concentrations of 35 to 40%. With this the maximum pulse amplitude from the scintillators is 30% of the pulse amplitude of multicrystalline stilbene under ^{60}Co γ radiation. The duration of the spark is 6.0×10^{-9} sec and does not depend on the concentration of the water in the scintillator. (tr-auth)

22152 REARRANGEMENT OF DATA OBTAINED BY MEANS OF MULTICHANNEL SPECTROMETERS. Tishechkin, A. S.; Chubarov, S. I. Prib. Tekh. Eksp., No. 1, 88-90(Jan.-Feb. 1967). (In Russian).

A method for the rearrangement of spectra obtained during nuclear physics experiments was described. An evaluation of the method is given. A block diagram of the microprogram, realized on the special computer installation was described. (tr-auth)

22153 HODOSCOPE WITH PULSE FEED OF THE GAS DISCHARGE COUNTER WITH A LARGE NUMBER OF COMPARTMENTS. Vavilov, Yu. N. (Lebedev Inst. of Physics, Moscow). Prib. Tekh. Eksp., No. 1, 94-7(Jan.-Feb. 1967). (In Russian).

A hodoscope with 2,016 compartments, used in the study of wide atmospheric showers of cosmic radiation, was described. Data on its exploitation are reported. (tr-auth)

22154 COLORIMETRIC METHOD FOR THE IDENTIFICATION OF ISOTOPES WITH GAMMA RADIATION. Volkov, N. G.; Lyapidevskii, V. K.; Chigir', S. D. (Moscow Engineering-Physics Inst.). Prib. Tekh. Eksp., No. 1, 142-5(Jan.-Feb. 1967). (In Russian).

A method for the identification of γ-emitting isotopes, based on the utilization of three detectors with different dependencies of the effective detection on energy, was analyzed. The identification is carried out by means of chromatic graphs, on the axis of which are plotted the recording velocities of the first and second detectors, divided by the recording velocity of the third. Other methods for the construction of the chromatic graphs are possible. The use of the method is examined. (tr-auth)

22155 SINGLE ELECTRON SENSITIVITY OF PHOTOMULTIPLIER TUBES. Yakushin, V. V. (Lebedev Inst. of Physics, Moscow). Prib. Tekh. Eksp., No. 1, 154-8(Jan.-Feb. 1967). (In Russian).

A method for the determination of the sensitivity of a scintillation counter by means of a collection of neutral optical filters was described. (tr-auth)

22156 A COAXIAL Ge(Li) GAMMA-RAY SPECTROMETER. Sakai, Eiji; Suzuki, Toshio; Gotoh, Hiroshi; Sekiguchi, Nobutada (Japan Atomic Energy Research Inst., Tokyo). J. Nucl. Sci. Technol. (Tokyo), 3: 534-8(Dec. 1966).

A single-open-end coaxial type Ge(Li) γ-ray detector with an effective volume of 8.7 cm^3 and a capacitance of 35 pF was made by Li-drifting for 440 hr at an applied voltage of 140 V at 40°C in thermomodule-controlled constant-temperature water coolant. The fwhm energy resolution with an E810F preamplifier was 4.2 and 8.0 keV for γ rays of 0.122 and 1.173 MeV, respectively. The pulse height distributions of γ rays from an irradiated natural U sample and ^{103}Rh isotope were measured. (auth)

22157 DETERMINATION OF DOSE VALUE FOR PRODUCTS OF NUCLEAR REACTION $^{10}B(n,\alpha)^7Li$ AND TEMPERATURE IN REACTION ZONE BY ACTION OF THERMAL NEUTRONS ON BORATE GLASSES. Gabsatarova, S. A.; Kabakchi, A. M. At. Energ. (USSR), 21: 519-20(Dec. 1966). (In Russian).

The energy imparted to a medium from alpha particles and ^{7}Li nuclei was estimated. Thermal neutrons interacted with boron glass containing 16.5% B_2O_3. The optimum thickness of the alpha-emitting layer was assumed to be equal to the range of the alpha particle in mica (1.15 mg/cm^2). This layer was subdivided into 10 individual sublayers, and the average energies of the alpha particles for each of these parallel sublayers were determined at various angles to obtain the radiation intensity P which was calculated from the reaction: $P = \pi\sigma N_\alpha E_\alpha$. Here π is the thermal neutron flux equal to 1.12×10^{11} neutrons cm^{-2} sec^{-1}; σ is the effective boron cross-section equal to 7.55×10^{-22} cm^2; N_α is the number of alpha particles in each sublayer at an angle ϕ; E_α is the average energy of these particles in eV. The energy absorbed from ^{7}Li nuclei was calculated in an analogous fashion. The absorbed dose in an ampul having an internal surface of 10 cm^2 and containing 1.55×10^{-2} g of heptane was 4,470 rads/sec. The experimental value was found to be 4,510 rads/sec as determined from dosimeters consisting of colored films of polyvinyl-alcohol containing methylene blue. The temperature in the ampul over the interval from 250 to 450°C was a linear function of the reactor power. This system is of interest for hydrocarbon cracking by combined radiation and thermal treatment. (TTT)

22158 PARAFFIN MIRRORS FOR ULTRASOFT X-RAYS. Herglotz, H. K. (E. I. du Pont de Nemours and Co., Wilmington, Del.). Nature, 214: 263-5(Apr. 15, 1967).

The study described was in connection with a suitable dispersion technique to identify ultra-soft x radiation of wavelength >20 Å. In this context the wavelength dependence of the critical angle of total reflection was considered; this critical angle exists only if the reflector is transparent to radiation. Beryllium would appear the best choice for a low-absorption reflector, but commercial beryllium is not sufficiently pure. Even a small proportion of impurities such as Fe or Ni, combined with the surface BeO, can destroy the critical angle. Paraffin can be obtained pure, and on account of its high hydrogen content and low density it shows only slight absorption at x-ray wavelengths that do not excite fluorescent carbon radiation. In order to evaluate paraffin as an ultra-soft x-ray reflector reflection curves were calculated for the characteristic K-radiations of F, O, N, C, B, and Be. Paraffin showed a sharp drop in intensity at the critical angle for the characteristic radiations of C and B. Practical applica-

tions of paraffin mirrors to ultra-soft x-ray spectroscopy require electronic read-out. The fall at the critical angle was experimentally verified with a photoelectron multiplier read-out. (UKAE)

22159 DEVELOPMENT OF HYDROGEN BUBBLE CHAMBERS. Briandet, Ph. (Laboratoire L. Leprince-Ringuet, Paris). Rev. Roum. Phys., 11: 777-81(1966). (In French).

The discussion of the development of hydrogen bubble chambers includes the present state of the technique and associated electronic systems, detectors, and the magnetic field. The French program for the development of hydrogen bubble chambers is also described. (J.F.P.)

22160 MEASUREMENT OF ALPHA-ACTIVITY WITH SAMPLES OF LOW SPECIFIC ACTIVITY. Haberer, K.; Preka, N. (Technische Hochschule, Karlsruhe, Ger.). Kerntechnik, 9: 65-8(Feb. 1967). (In German).

A method is described which allows measurement of the low specific α-activity of samples (which are obtained, e.g., in environment survey) by usual equipment under optimum conditions. The basic assumption is that there is usually enough sample material to produce the samples in layers saturated for α-radiation. The α-radiation of such samples can be measured under easily reproducible conditions with optimum counting rate. The strong energy dependence which is a disturbing effect in absolute measurements with unknown sources will be less significant in view of the relatively small energy range of the more frequent α-emitters. Therefore the measurements will be sufficiently precise for environment survey. Formulas and diagrams for energy correction are presented. (auth)

22161 NUCLEAR ELECTRONICS: A DIGITAL RATEMETER FOR A NEUTRON MONITOR. Petrick, D. (Hahn-Meitner-Institut fuer Kernforschung, Berlin). Kerntechnik, 9: 72(Feb. 1967). (In German).

A digital ratemeter for a simple neutron monitor is described. It contains alarm circuits and arrangements for the display of the momentary dose-rate equivalent and the total absorbed dose equivalent. (auth)

22162 STUDY BY MEANS OF A SEMICONDUCTOR DETECTOR WITH A BORON CONVERTER OF THE DISTRIBUTION OF THERMALIZED NEUTRONS IN THE CENTRAL CHANNEL OF A HYDROGENOUS MODERATOR. Robaye, G. Bull. Soc. Roy. Sci. Liege, 35: 704-10(1966). (In French).

The distribution of thermalized neutrons in the central channel of a long counter was measured using a semiconductor detector with a boron converter. The effect of a cadmium sleeve on the response of a long counter was measured for different neutron energies and for different dimensions and positions of the sleeve. (D.C.W.)

22163 DISCHARGE-CONDENSATION METHOD OF DETECTING CHARGED-PARTICLE TRACKS. Mandzhavidze, Z. Sh.; Roinishvili, V. I. (Inst. of Physics, Tbilisi, USSR). JETP Lett. (USSR)(Engl. Transl.), 5: 139-40(Mar. 1, 1967).

Translated from Zh. Eksp. Teor. Fiz., Pis'ma Redaktsiyu, 5: 173-5(Mar. 1, 1967).

The discharge–condensation method for the detection of the charged particle tracks combines the high time resolution of spark chambers and the long time of memorization of a selected event which is characteristic of condensation chambers. The principle of the discharge–condensation method and the design of the chamber are given. A photograph of a cosmic particle track in a discharge-condensation chamber is shown. (J.F.P)

22164 INVESTIGATION OF CHARACTERISTICS OF SCINTILLATION PLASTIC GRANULAE. Tsirlin, Yu. A.; Shvets, V. A.; Berlovskii, A. Ya.; Solomonov, V. M. Zh. Prikl. Spektrosk., Akad. Nauk BSSR, 6: 85-9(Jan. 1967). (In Russian).

The theory of light diffusion in scattering media is applied to the layers of scintillation plastic granules. The layers absorption coefficient, scintillation efficiency, and material absorption coefficient are determined. Theory and experimental results are in good agreement. (auth)

22165 FAST FISSION CHAMBER AMPLIFIER (Engineering Materials). (Oak Ridge National Lab., Tenn.). (CAPE-1566).

2 drawings.

An amplifier-discriminator and pulse shaper used with a fast fission chamber are described. The equipment measures the fission cross section of ^{233}U. The amplifier-discriminator consists of three stages plus an output common-base buffer amplifier. The configuration affords a simple means of obtaining high current gain, fast rise time, low noise, good stability, and the use of inexpensive transistors. (For details see TID-4100 Suppl. 39.) (F.S.)

22166 IMPROVEMENTS IN RADIATION DETECTORS. (to Groupement Atomique Alsacienne Atlantique). British Patent 1,061,341. Mar. 8, 1967. Priority date Jan. 15, 1964, France.

A neutron detector is described which employs boron trifluoride and is constructed mainly of titanium in order to be used at extreme temperatures. (B.G.D.)

22167 GAMMA COMPENSATED NEUTRON ION CHAMBER. (to General Electric Co.). British Patent 1,063,833. Mar. 30, 1967. Priority date May 13, 1963, United States.

A gamma-compensated neutron ionization chamber is described for measuring neutron radiation levels in the presence of simultaneous gamma radiation in excess of 10^4 R/hr. (B.G.D.)

22168 TWO PIECE RADIATION DETECTOR. (to Bendix Corp.). British Patent 1,061,244. Mar. 8, 1967. Priority date July 27, 1964, United States.

A two-piece radiation detector is described which has an eyepiece assembly which is removable from the radiation transducer (ionization chamber) and electrometer assembly. (B.G.D.)

Radiation Dosimeters

22169 (ISS-66/42) DOSE DISTRIBUTION OF HIGH ACTIVITY ^{60}Co SOURCE THROUGH GLASS DOSIMETRY. Grisanti, A.; Tori, P. (Istituto Superiore di Sanita, Rome (Italy). Laboratori di Fisica). Nov. 10, 1966. 17p. Dep. mn.

The relative merits of methods suited for the dosimetry of large isotopic sources are discussed. The results of a calibration of a Gammabeam 650 source with glass dosimeter are presented. The concluding remarks show not only the feasibility of the method but also the possibility of extending the use of the glass dosimeter to dose distribution determination of sources of therapeutic interest. (auth)

22170 (NP-16701) RETNINGSKARAKTERISTIK OG NEUTRONFOELSOMHED FOR DOSIMETRE MED IONISERINGSKAMMER. (Directional Characterisitics and Neutron Sensitivity of Ionization-Chamber Dosimeters). Johansen, Gunnar (Forsvarets Forskningsrad, Copenhagen (Denmark)). Aug. 1966. 36p. (In Danish). Dep.

A project aimed at the development of a low-cost pocket dosimeter of the ionization-chamber type has been concluded. The dosimeter is indirectly readable. It can be stored in charged condition ready for use for several years. The directional sensitivity of the dosimeter to x-rays is investigated. The voltage drop varies ±19% for the aluminum type and ±17% for the Perspex type. A study is made of the neutron sensitivity of the dosimeter, defined by V per rem of neutron radiation/V per rem of gamma radiation. It is 4–6% for the aluminum type and 6.5–19% for Perspex type. As the neutron sensitivity is not equal to 1, the dosimeter cannot measure the sum of the neutron and gamma doses. In a mixed radiation field it measures the gamma dose with an uncertainty of 20% in most of the situations to which the civilian population is exposed. By using two dosimeters with different neutron sensitivity the neutron as well as the gamma dose can be measured. It is shown that the neutron dose is often so large that it should be measured. (auth)

22171 (AEC-tr-6712) PHOTOGRAPHIC DOSIMETRY OF IONIZING RADIATIONS. Kozlov, V. F. Translation of Fotograficheskaya Dozimetriya Ioniziruyushchikh Izluchenii, Atomizdat, Moscow, 1964. 132p. (IPST-Cat.-1808). Dep. mn. CFSTI $3.00 cy, $0.65 mn.

Photographic dosimetry of ionizing radiations is plagued by some fundamental deficiencies. Stationary exposures are fairly accurate, but in practice the results obtained from film badges worn by the monitored personnel are much poorer. The lower the photographic density, the higher the errors. Measurements of gamma-ray doses in the 30–100 mr range by the film badge technique are generally in error by as much as a factor of two in either direction. The errors moreover build up due to intermittency, and the films should therefore be worn continuously for a fairly long period (a few weeks). Although the energy dependence of the film is substantially suppressed by suitable filters (to within ±20%), in some cases the personnel are exposed to radiations whose energy lies outside the compensated region (e.g., very soft x rays). The results are then in error by more than a factor of two; this low accuracy is a common characteristic of the general filter technique for effective energy determination. (auth)

22172 NUCLEAR INSTRUMENTATION. NO. 27. Instrum. Nucl. (Paris), No. 27, 1-52(Jan. 1967). (In French).

The design and specifications of the tissue equivalent detectors, amplifiers, standaridized functional elements, counting devices,

specialized measurement devices, prospection, and measurement devices recently developed by the C.E.A. are reported. The devices described include a fast pulse amplifier, amplitude discriminator, coincidence selector, α-β activity counter, tissue equivalent ionization chamber, uranium sampling equipment, mass spectrometer, and nanosecond amplifier. The use of the Campbell method in the control instrumentation of nuclear reactions is outlined. (J.S.R.)

22173 NEW ELECTRONIC DEVICE FOR RADIOTHERMOLUMINESCENT RESEARCH. Mishev, I.; Levi, S.; Radicheva, M.; Zhelyazkov, V. (Inst. of Physics, Sofia). Compt. Rend. Acad. Bulg. Sci., 20: 17-20(1967).

An instrument is described for reading information stored in thermoluminescent dosimeters. The main components of the instrument are: photomultipliers, output meter, diaphragms and light filters, and a heating device. The basic parameters of the instrument are also presented. (B.G.D.)

22174 ADVANCES IN THERMOLUMINESCENT DOSIMETRY. Cameron, John R. (Univ. of Wisconsin, Madison). pp 43-5 of IVth Nordic Meeting on Clinical Physics, Proceedings. Rytila, A.; Spring, E. (eds.). Helsinki, University Central Hospital, 1966.

The advantages of thermoluminescent detectors for use as γ radiation dosimeters are discussed. It is pointed out that the useful sensitivities of LiF and CaF_2 phosphors have been improved by better instrumentation and that readings of a few mR are possible with LiF and as low as 0.1 mR with CaF_2. The use of $CaSO_4$:Mn for special applications at low temperatures is discussed. (C.H.)

22175 PLACE OF THERMOLUMINESCENCE DOSIMETERS AND IONIZATION CHAMBERS IN PRACTICAL DOSIMETRY. Fowler, J. F. (Hammersmith Hospital, London). pp 46-57 of IVth Nordic Meeting on Clinical Physics, Proceedings. Rytila, A.; Spring, E. (eds.). Helsinki, University Central Hospital, 1966.

The performance of thermoluminescent detectors and ionization chambers for radiation dosimetry are compared. It is pointed out that both detectors have certain advantages and that the choice will depend on the dosimetric problems involved. (C.H.)

22176 THERMOLUMINESCENCE DOSIMETRY, APPARATUS, METHODS, AND APPLICATIONS. Carlsson, Carl (Univ.of Lund, Sweden). pp 58-60 of IVth Nordic Meeting on Clinical Physics, Proceedings. Rytila, A.; Spring, E. (eds.). Helsinki, University Central Hospital, 1966.

In thermoluminescent dosimetry there is a need for the simultaneous recording of both the integrated light and the glow-curve. The light sum is proportional to the absorbed dose in the dosimeter and the glow curve indicates the state of the dosimeter. These two quantities may be measured by integrating the current from the photomultiplier tube, giving the light sum, and recording the current through the condenser by means of a resistance, electrometer, and recorder, or by feeding a small condenser with current from the photomultiplier tube. The condenser will be discharged at a pre-set voltage giving a pulse by means of a multivibrator circuit. A scaler will count the number of pulses, thereby giving the light sum, and a rate meter with recorder connected in parallel with the scaler will give the glow curve. The second system was found to be faster and to give the best glow curves together with a larger measuring range. Steep gradients in absorbed dose were measured with this system. Some applications of LiF-teflon dosimeters for the measurement of absorbed dose from γ and x radiation in phantoms are described. (C.H.)

22177 DOSIMETRY WITH LiF-TEFLON DOSIMETERS. Martensson, Bengt (Univ. of Lund, Sweden). pp 61-2 of IVth Nordic Meeting on Clinical Physics, Proceedings. Rytila, A.; Spring, E. (eds.). Helsinki, University Central Hospital, 1966.

The performance of LiF thermoluminescent dosimeters is dependent upon the heat treatment of the dosimeter. Problems involved are discussed. Procedures are described for the heat treatment of loose LiF powder and of LiF-teflon dosimeters. Experiments showed that with highly reproducible heat treatment of the dosimeters between γ irradiations a constant sensitivity was obtained. (C.H.)

22178 LiF DOSIMETER FOR INTRACAVITARY MEASUREMENTS. Lindskoug, Bengt (Sahlgrenska Sjukhuset, Goteborg). pp 63-4 of IVth Nordic Meeting on Clinical Physics, Proceedings. Rytila, A.; Spring, E. (eds.). Helsinki, University Central Hospital, 1966. (In Dutch).

The use of LiF powder in a fixed geometry as a thermoluminescent dosimeter for measurements of γ dose in biological materials or in phantoms of very small volume is reported. An accuracy of measurement of 3% was obtained when nitrogen-filled probes were used and the radiation dose did not exceed 300 rads. Reference probes irradiated with a known dose were used to correct for any change in sensitivity. (C.H.)

22179 FILM DOSIMETRY: AN INVESTIGATION WITH GAMMA RAYS USING TWO TYPES OF FILMS. Pharm, Yngvar; Lie, Andreas (Det Norske Radiumhospital, Norway). pp 65-6 of IVth Nordic Meeting on Clinical Physics, Proceedings. Rytila, A.; Spring, E. (eds.). Helsinki, University Central Hospital, 1966.

The sensitivity of two films, Kodak Microtex and Gevaert-N-51-p, for use for γ dosimetry were compared. Measurements were made at 0.5 cm and 20 cm in a water phantom. Film density was measured along the central axis. Data are presented on the effects of film density on sensitivity at various depths. (C.H.)

22180 QUASI-STATIONARY CALORIMETRIC METHOD OF DOSIMETRY OF POWERFUL FLUXES OF IONIZING IRRADIATIONS. Kolyada, V. M.; Karasev, V. S.; Pedchenko, K. S. At. Energ. (USSR), 21: 520-2(Dec. 1966). (In Russian).

Neutron fluxes of 10^{15} thermal neutrons cm^{-2} sec^{-1} can result in energy absorptions of tens of watts per gram of nonfissioning material. A calorimeter based on the time required to melt a definite mass of crystalline material was designed and tested for the determination of reactor radiation. The absorbed dose is related to the melting time as follows: $Q = (\lambda m/\Delta\tau) + k$. Here Q is the energy per unit time absorbed by the calorimeter; λ is the heat of fusion; m is the mass of crystalline material; $\Delta\tau$ is the melting time, and k is the heat loss per unit time by the calorimeter under isothermal conditions ($T_{melt.} - T_{wall}$ = const). Calibration of the equipment at a flux of 10^{14} neutrons cm^{-2} sec^{-1} is discussed. Additional heat was supplied to the calorimeter when tin was used as the working substance at a reactor power of 8 megawatts. The results were accurate to 6%. The equipment was simple, and required temperature measurements on only a single thermocouple. The apparatus could be used at even higher neutron fluxes. (TTT)

22181 THE USE OF FARMER-BALDWIN AND VICTROMETER IONIZATION CHAMBERS FOR DOSIMETRY OF HIGH ENERGY X-RADIATION. Greene, D.; Massey, J. B. (Christie Hospital and Holt Radium Inst., Manchester, Eng.). Phys. Med. Biol., 12: 257-8(Apr. 1967).

Since the publication of the paper on this subject by the authors in Phys. Med. Biol., 11: 569 (1966) some new electron stopping power data have become available. These are used to recalculate the values of the factor C_λ. The new data include values for collision stopping power and radiation stopping power. Recalculated values of C_λ are tabulated. The new values do not differ from previous values up to 20 Mv, but differ significantly for higher energies, where the loss of energy by bremsstrahlung production becomes appreciable. Satisfactory agreement is obtained between the calculated and measured values of C_λ over the quality range up to 35 Mv. (UKAE)

22182 NEUTRON SURVEY METER (Engineering Materials). (California Univ., Livermore. Lawrence Radiation Lab.). (CAPE-1564).

1 drawing.

The electronic equipment for a neutron survey meter which is used to measure complex neutron spectra, rich in intermediate energy neutrons (0.5 eV to 10 keV) is described schematically. The meter measures to ±10% of the theoretical dose rate and the sensitivity is from 2 to 200 mRem/hr. The electronic equipment comprises a count rate meter, high voltage supply, meter scale, and a BF_3 detector 1 in. in dia with an active length of 2 in. The detector is filled at a pressure of 60 cm Hg and is γ insensitive to >500 R/hr of ^{137}Cs γ radiation. The meter weighs 21.6 lbs. (For details see TID-4100 Suppl. 39.) (F.S.)

Radiometric Instruments

Refer also to abstracts 22033, 22084, 22109, and 23008.

22183 (ORO-3325-1) A SEDIMENT POROSITY METER: A FEASIBILITY STUDY. Wilson, Billy F.; Youmans, Arthur H. (Lane-Wells Co., Houston, Tex.). June 1966. Contract AT (40-1)-3325. 72p. Dep. mn. CFSTI $3.00 cy, $0.65 mn.

The technical feasibility of measuring both density and moisture content of unconsolidated sediments by means of a probe employing nuclear sensing devices was studied. The proposed probe is comprised of a sensing system and associated electronics mounted in an elongated housing which is lowered on a cable into the sediments. Density is sensed by a gamma-gamma system, and the moisture content by a neutron-neutron system such as used for

rock porosity measurements in oil well logging. Because the system responds to the hydrogen content as well as the moisture content in constituent clay minerals, additional measurements are desirable to eliminate this ambiguity. Supplemental measurements of natural gamma radiation, acoustic velocity, electrical conductivity, and fast neutron activation were considered. Construction of a multiple purpose instrument for these measurements is recommended. (L.C.L.)

22184 DEEP WATER ISOTOPIC CURRENT ANALYZER III (DWICA III) (Engineering Materials). (Johnston (William H.) Labs., Inc., Baltimore, Md.). (CAPE-1493).

30 drawings.

The Deep Water Isotopic Current Analyzer (DWICA III) consists of an underwater unit and a surface unit. Operation is based on the use of radioisotopes to sense the change in tilt angle of a suspended underwater structure produced by the drag force exerted by water currents. The underwater structure consists of a compass card with a sealed radioactive source either on the north or east point of the compass card a sealed ionization chamber surrounding the compass card and a graded shield. The surface unit contains the data recording unit and electronic equipment. The equipment may be operated unattended. (For details see TID-4100 Suppl 40) (F.S.)

22185 IMPROVEMENTS IN OR RELATING TO APPARATUS FOR MEASURING DUST CONCENTRATION. (to Institut National de Recherche Chimique Appliquee). British Patent 1,060,880. Mar. 8, 1967. Priority date July 9, 1964, France.

An apparatus is described which measures the concentration of dust in a gas. The gas of which the dust content is to be measured is drawn through a movable or fixed filter layer of paper, felt, textile, or other material. A source of α, β or γ radiation is located on one side of the filter which is loaded with dust. The value of the attenuation of the intensity of radiation by the dust on the filter is measured by a Geiger-Mueller counter. (F.S.)

22186 IMPROVEMENTS IN OR RELATING TO METHOD AND APPARATUS FOR PULSED WELL LOGGING. Youmans, Arthur Homer (to Dresser Industries, Inc.). British Patent 1,065,784. Apr. 19, 1967. Filed Apr. 7, 1964.

Equipment is described which is used in geophysical prospecting, particularly in radioactive well logging. The equipment is comprised of a source of neutrons with a method for irradiating a medium with a burst of high-energy neutrons, one or more radiation detectors adapted to detect radiations returning from the medium, and a recording method arranged to record the rate of decline of the radioactivity in correlation with an indication of the depth of the well. (F.S.)

Miscellaneous Instruments and Components

Refer also to abstracts 22062, 22079, 22172, 23079, 23166, and 23167.

22187 (AWRE-O-102/66) SAFETY ATTACHMENTS FOR X-RAY DIFFRACTION APPARATUS. Hambling, P. G.; Sampson, C. F. (Atomic Weapons Research Establishment, Aldermaston (England)). Feb. 1967. 16p. Dep. mn. CFSTI $3.00 cy, $0.65 mn. HMSO 3s. 3d.

Attachments are described for a Hilger 9 cm x-ray-powder diffraction camera type Y103, and for a Philips PW1010/1050 diffractometer, which enable them to be used in conformity with the relevant parts of the Code of Practice for the Protection of Persons Exposed to Ionizing Radiation in Research and Teaching. (auth)

22188 (BNL-994, pp 37-44) INSTRUMENTATION. (Brookhaven National Lab., Upton, N. Y.).

Developments in instrumentation at Brookhaven are reviewed. The developments fall into three categories: radiation detectors, computer systems, and circuits. The development of radiation detectors involves fabrication of lithium-drifted germanium detectors for high resolution gamma spectrometry, improvements in the field of readout spark chambers, and thermoluminescent dosimeters for health physics. Computer systems are being developed for use with radiation detectors, neutron time-of-flight analysis, bubble chamber film scanning tables, and digital wire spark chambers. (B.G.D.)

22189 (BNWL-377) INFRARED DETECTION OF NUCLEAR REACTOR COOLANT IMPURITIES. Brenden, B. B.; Coleman, W. J.; Moore, G. E. (Battelle-Northwest, Richland, Wash. Pacific Northwest Lab.). Feb. 1967. Contract AT(45-1)-1830. 16p. Dep. mn. CFSTI $3.00 cy, $0.65 mn.

An experimental absorption hygrometer was developed to measure the water vapor content in a flowing stream of gas. The indicated accuracy of the instrument, in terms of dew point, is ±2°F over a range of dew points from −46°F to +56°F. To facilitate appropriate calibration of the hygrometer, a variable pressure saturator was developed and utilized. Based upon extensive tests of the initial hygrometer, the development and fabrication of a second generation system, termed Mark II, were undertaken with the expectation of improved accuracy and reliability. (auth)

22190 (CEA-BIB-77) GENERATION D'OSCILLATIONS DANS LES MILIEUX SEMICONDUCTEURS. (Oscillation Production in Semiconducting Media). Pruriaux, Bernard (Commissariat a l'Energie Atomique, Grenoble (France). Centre d'Etudes Nucleaires). Feb. 1967. 23p. (In French). Dep. mn.

The production of microwave oscillations by the application of a strong electric field to a crystal semiconductor (Gunn effect) is studied from the phenomenological and theoretical points of view. Devices based on this principle, in the form of oscillators or amplifiers in the billion cycles/second range, have been built. The performances obtained appear to be very promising. (tr-auth)

22191 (GA-7413) THE DEVELOPMENT OF AN ACOUSTICAL THERMOMETER FOR A GRAPHITE MATRIX NUCLEAR FUEL ELEMENT. Roes, J. B.; Peat, D. L. (General Dynamics Corp., San Diego, Calif. General Atomic Div.). Oct. 8, 1966. Contract AT(04-3)-167. 16p. (CONF-661020-17). Dep. mn. CFSTI $3.90 cy, $0.65 mn.

From 13th Annual Nuclear Science Symposium, Boston, Mass.

The development of an acoustical thermometer for use in graphite matrix nuclear fuel elements is described. Test results indicate that this thermometer accomplished the objective of automatically, accurately, and reliably recording temperatures of a number of sensors. The acoustical thermometer system offers a wider choice of signal transmission line and sensor materials than conventional thermometer systems, since it does not require the use of electrical insulators or the conductors in them. This advantage was the main reason for choosing the acoustical thermometer for use in the particular environment of interest. While the development of the thermometer was directly aimed at the solution of problems associated with a nuclear and carbonaceous environment, a number of observations are presented that should be pertinent to a acoustical thermometer design in general. (auth)

22192 (INR-746/III/E) LINEARNY NIEPRZECIAZALNY WYSOKOSTABILNY WZMACNIACZ PODWOJNIE ROZNICZKUJACY. (A Nonoverloading High Stability Linear Pulse Amplifier). Bayer, Ryszard (Institute of Nuclear Research, Warsaw (Poland)). Sept. 1966. 10p. (In Polish). Dep.

A nonoverloading high stability linear pulse amplifier was built. Its operation principle solution and characteristics are described. Some results of measurements are given. (auth)

22193 (IS-1544) DESIGN AND OPERATION OF A SLOW NEUTRON CHOPPER. Struss, Roland George (Ames Lab., Iowa). Mar. 1966. Contract W-7405-eng-82. 48p. Dep. mn. CFSTI $3.00 cy, $0.65 mn.

The general parameters and equations defining slow neutron chopper design and operation are presented. A description of the modulation of an incident neutron beam by the chopper is given in some detail. This is developed into an aperture function which can be utilized for corrections of the counted spectrum to relate it to the incident spectrum. The principles of operation of a slow neutron chopper are given in sufficient detail to allow the experimenter to utilize the time of flight technique for a number of experiments. The design, fabrication, and initial operation of a slow neutron chopper is presented in detail. The results of the initial operation are given to show the measurement of the velocity spectrum in the graphite thermal column of the reactor. Some recommendations for future work are made in the conclusions. (auth)

22194 (N-67-14927) MASS SPECTROMETER ANALYSIS OF SOLID MATERIALS WITH THE ION-MICROPROBE SPUTTER SOURCE. Herzog, R. F. K.; Poschenrieder, W. P.; Satkiewicz, F. G. (GCA Corp., Bedford, Mass. GCA Technology Div.). Jan. 1967. Contract NAS5-9254. 43p. (NASA-CR-683). CFSTI $3.00 cy, $0.65 mn.

Several instrumental improvements to the sputter ion source mass spectrometer are described, with the introduction of the so-called energy window considered of great importance. It makes uses of the discovery that the initial energy distribution of atomic ions differs significantly from the energy distribution of molecular ions. When the energy window is properly set, either predominantly atomic or molecular spectra can be obtained. Very heavy molecules such as Al_{18} can be detected. These molecules may be regarded as microcrystalline units of the material and their composition obviously reflects the crystalline structure of the material. The potential use of the instrument for a more sophisticated analysis of solids is stressed. Geological applications are discussed,

and data given on the analysis of two samples. The possibility of measuring low concentration isotope ratios in the strontium and rare earth region in the complex matrix of a rock was investigated, including the selection and preparation of proper fluxing agents. (auth)

22195 (NP-16705) TRANSISTORISERET DOSIMETERAFLAESER. EN FORSOEGSMODEL. (Transistorized Dosimeter Reader: Test Model). Buchhave, Preben (Forsvarets Forskningsrad, Copenhagen (Denmark)). Apr. 1966. 29p. (In Danish). Dep.

A fully transistorized reading instrument for ionization-chamber personnel dosimeters was designed. It has a rugged moving-coil instrument for dose reading; it is portable and easy to operate. A field-effect transistor (FET) is the active element of the electrometer input. As the main purpose was to propose applicable circuits for a field instrument, only temperature tests were performed, and no attempt was made to find final solutions to such problems as dust, moisture and shock proofing, or automation and data handling. The reader design was an integrating part of a development project concerning low-cost dosimeters with time constants of more than 100 years. (auth)

22196 (ORNL-4083) MATHEMATICS DIVISION ANNUAL PROGRESS REPORT FOR PERIOD ENDING DECEMBER 31, 1966. Feliciano, Manuel Jr. (comp. and ed.) (Oak Ridge National Lab., Tenn.). Apr. 1967. Contract W-7405-eng-26. 127p. Dep. mn. CFSTI $3.00 cy, $0.65 mn.

An annual progress report is presented on mathematics and computing and mathematical statistics at ORNL during the period ending December 31, 1966. Topics include research; computing services; and statistical research, programming, and applications. (B.G.D.)

22197 (RA-20) VERGELIJKEND ONDERZOEK NAAR PULSHOOGTE-ANALYSATOREN. (Comparative Studies of Multichannel Pulseheight Analyzers). van den Adel, H. Ch. (Rijks Instituut voor de Volksgezondheid, Utrecht (Netherlands)). [nd]. 35p. (In Dutch). DTIE.

Comparative inquiries were made into subjoined multichannel pulse analyzers. The analyzers under consideration were: T.M.C., Nuclear Data, Intertechnique, Laben, Victoreen, R.I.D.L., R.C.L., and Philips. The investigation concerned features, linearity, stability, price, service, and guaranty. (B.C.D.)

22198 (RISO-M-481) DESCRIPTION OF THE MOPS-II-C PROGRAMME. Oelgaard, P. L. (Danish Atomic Energy Commission, Risoe, Research Establishment). Feb. 1967. 19p. Dep. mn.

The MOPS-II-C program described allows the calculation of the calibration curve (count-rate versus moisture content) of a neutron moisture gage situated in an infinite soil, moisture medium with known dry soil composition. The source-detector arrangement considered is a line detector for thermal (and if required epithermal) neutrons with the fast neutron source Ra(α,n)Be source or equivalent situated at the detector axis, but outside the detector. A discussion of the basis of the program and of the input and output data is given together with a write-out of the entire program in GIER-ALGOL-III. (auth)

22199 (SC-RR-67-190) CALCULATIONS FOR A LOW DENSITY PLASMA IMPEDANCE BRIDGE. Harris, Robert W. (Sandia Corp., Albuquerque, N. Mex.). Apr. 1967. Contract AT-(29-1)-789. 28p. Dep. mn. CFSTI $3.00 cy, $0.65 mn.

An electrodeless null method for plasma impedance measurements is proposed. Calculations using the standard complex plasma conductivity expression indicate that the method should be sensitive to conductivities at least as low as 1 mho/meter at a bridge frequency of 1 Mc. The results indicate that at low densities ($\sim 10^{10}$ electrons cm^{-3}) the method is sensitive mostly to number density, although it may be possible to determine temperature also by a phase measurement technique. At higher densities ($\sim 10^{14}$ cm^{-3}) the method becomes insensitive to density and dependent mostly on temperature. (auth)

22200 (SCL-DR-67-40) FREQUENCY-MODULATED TIME-OF-OCCURRENCE MARKER. Johnston, H. R. (Sandia Corp., Livermore, Calif.). Apr. 1967. Contract AT(29-1)-789. 137p. Dep. mn. CFSTI $3.00 cy, $0.65 mn.

The frequency-modulated time-of-occurrence marker is a new device designed to replace the Mod 6, an amplitude-modulated time-of-occurrence marker. The new device frequency-modulates the subcarrier with pulses of three different durations in a manner analogous to the amplitude modulation of Mod 6. The FM device allows the use of the 52.5-kc and the 70-kc subcarrier oscillators in the same TM pack. It has been demonstrated in the laboratory that the FM device functions satisfactorily at a signal-to-noise ratio at which the AM device (Mod 6) tends to become inaccurate or useless. The nominal accuracy of the FM system in the absence of noise can be stated as (–10 ± 7) microseconds. (auth)

22201 (SCL-TN-66-113) ONE-POINT SAMPLER. Olson, H. W. (Sandia Corp., Livermore, Calif.). Jan. 1967. Contract AT(29-1)-789. 2p. Dep. mn. CFSTI $3.00 cy, $0.65 mn.

A simple one-point sampler was devised to determine the amplitude of a fast transient pulse during an increment of time very brief compared to the total duration of the pulse. The unit constructed of off-the-shelf parts achieved accuracies of plus or minus two nanoseconds when measuring pulses with fifty nanosecond rise times. (B.G.D.)

22202 (UCRL-16520) FIELD ION METALLOGRAPHY. Ranganathan, S. (California Univ., Berkeley. Lawrence Radiation Lab.). Oct. 1965. Contract W-7405-eng-48. 15p. Dep. mn. CFSTI $3.00 cy, $0.65 mn.

The use of the field ion microscopy in metallography is discussed in terms of its past achievements and future potential. (P.C.H.)

22203 (WANL-TME-1254) NON-NUCLEAR EVALUATION TESTING OF STRAIN GAGES BONDED WITH CERAMIC CEMENT. Kalning, L. (Westinghouse Electric Corp., Pittsburgh, Pa. Astronuclear Lab.). Aug. 27, 1965. Contract SNP-1. 62p. Dep. mn. CFSTI $3.00 cy, $0.65 mn.

The feasibility of using ceramic bonded strain gages on NERVA reactor components was investigated. The goal of this investigation was to develop a strain gage technique which would offer improved accuracy and have smaller physical dimensions than the Microdot weldable gages presently being used for diagnostic purposes on NRX reactors. In addition, a strain gage technique is needed for those reactor components such as the beryllium control drums where spot welding of the Microdot gages is not possible. Nonnuclear evaluation tests were conducted on strain gages bonded with ceramic cement to constant strain beams, tie rods, a control drum, and lateral support springs. Both static and dynamic tests were conducted over a temperature range of –320 to +600°F under loads simulating expected NERVA conditions. The results of this investigation revealed that the ceramic bonded strain gages are in many respects superior to the Microdot weldable gages. However, more development is needed to improve lead routing and strain gage connection techniques. In addition, it was demonstrated that present moisture-proofing techniques are inadequate for strain gage installations on certain reactor components after they have been subjected to cryogenic temperatures and exposed to room air. (auth)

22204 OPTICAL MATERIAL PROBLEMS OF INTERPLANETARY SPACE. Becker, Randolph A. (California Inst. of Tech., Pasadena). Appl. Opt., 6: 955-62(May 1967).

The successful flights of Mariners II and IV demonstrated that optical systems can survive and operate after months of exposure to interplanetary space. Special considerations must be taken in designing for deep space. The phenomena of sublimation and deterioration of solid materials in deep-space vacuum influence the selection of all materials used in the optical system including metals and organic compounds. Three basically different approaches of thermal design are available to the designer. Each method is capable of maintaining focus throughout large temperature excursions. Micrometeoroid and radiation damage are not major problems. The material selection for and thermal design of the Mariner IV television camera optical system is described. (auth)

22205 NOZZLE THERMOCOUPLE FOR MEASUREMENTS IN HIGH-TEMPERATURE GASES. Dalle Donne, M.; Bowditch, F. H. Int. J. Heat Mass Transfer, 10: 477-88(Apr. 1967).

A nozzle thermocouple was developed for measurement of high gas temperatures under conditions of low flow rate. Calibration curves for such thermocouples are given for monoatomic and diatomic gases. A method to take into account Reynolds number effect is indicated. (auth)

22206 FREQUENCY STABILIZATION OF THE POWER KLYSTRON USED IN A SPECTROMETER FOR THE MEASUREMENT OF RELAXATION TIME. Fabre, Francois; Pescia, Jacques (Laboratoire de Physique des Solides, Toulouse). Compt. Rend., Ser. B, 264: 680-3(Feb. 27, 1967). (In French).

The stabilization was realized with an assembly derived from the original Pound apparatus, but in which the intermediate frequency comes from the mixing of two hyperfrequency waves. Special precautions were taken because of the high power used. A description of the assembly, the analysis of its operation, and the results of performance tests are given. (tr-auth)

22207 RECORDING OF INFORMATION ON NARROW MAGNETIC TAPES FROM MANY TRANSMITTING ELEMENTS FOR SUBSEQUENT PROCESSING IN COMPUTERS. Nikol'skii,

S. I.; Subbotin, B. V.; Tukish, E. I.; Yakovlev, V. I. (Lebedev Inst. of Physics, Moscow). Prib. Tekh. Eksp., No. 1, 81-4 (Jan.-Feb. 1967). (In Russian).

The block diagram of the installation recording information of physical experiments on four-track narrow magnetic tape with subsequent introduction of the tape into an electronic digital computer was described. The form of the recording of the information on the magnetic tape and its quantity can be changed in agreement with concrete demands of the experiment. (tr-auth)

22208 SYSTEM OF MULTIMEASUREMENT ANALYSIS, PROGRAMMED FROM A LIGHT PENCIL. Kurashov, A. A.; Ogloblin, A. A.; Paramonov, V. V. (Inst. of Atomic Energy, Moscow). Prib. Tekh. Eksp., No. 1, 91-4(Jan.-Feb. 1967). (In Russian).

A system of multimeasurement analysis in which the management of the work of the multimeasurement analyzer is carried out by means of a programmed memory device and the region of parameter change is set with a light pencil is described. The system makes it very easy to measure spectra along random curves on the plane. (tr-auth)

22209 LINEAR GATE WITH LOW RESOLUTION TIME. Egiyan, E. Sh.; Sarkisyan, M. M. (Inst. of Physics, Erevan). Prib. Tekh. Eksp., No. 1, 97-8(Jan.-Feb. 1967). (In Russian).

A method for the construction of a linear gate is proposed, in which instead of the usual active load resistance a nonlinear element with two stable states is used. This makes it possible to reduce the load resistance in different work regimes of the gate so as to guarantee a small transmission time, a small parasite transmission in the nontransmission regime, and a small pedestal. One of the variants of the design of the linear gate with transistors and the results of its testing are reported. (tr-auth)

22210 DIODE COINCIDENCE CIRCUIT. Budyashov, Yu. G.; Zinov, V. G.; Morozov, A. G. (Joint Inst. for Nuclear Research, Dubna, USSR). Prib. Tekh. Eksp., No. 1, 99-101 (Jan.-Feb. 1967). (In Russian).

A simple coincidence circuit using diodes and transistors, based on the Garbin circuit, was described. (tr-auth)

22211 HIGH VOLTAGE STABILIZER FOR ELECTROMAGNETIC SEPARATOR. Naftulin, S. M. (Inst. of Atomic Energy, Moscow). Prib. Tekh. Eksp., No. 1, 148-50(Jan.-Feb. 1967). (In Russian).

The design of a high voltage stabilizer for an electromagnetic isotope separator was reported. The voltage at the stabilizer output is 40 kV, the charge current is approximately 1 A, the stabilization precision is 2×10^{-4}, and the stabilization coefficient of the system is 3,700. The time for the recording of the transition process of the voltage during sparkover in the ion source is 6×10^{-4} sec. (tr-auth)

22212 ION SOURCE FOR MASS SPECTRA STUDY OF THE ENERGY CHARACTERISTICS OF MOLECULES. Il'ina, G. G.; Rutgaizer, Yu. S.; Semenov, G. A. Prib. Tekh. Eksp., No. 1, 151-3(Jan.-Feb. 1967). (In Russian).

The industrial sample of the ion source IE-06 used in the mass spectrometer MX1308, designed for the study of evaporation processes and the energy characteristics of molecules of only slightly volatile substances was described. The source has standard dimensions and can be used in mass spectrometers of a different type. Some modifications of the assembly are possible; in one of these the Fox system is used for the quasimonochromatization of the electron beam. The error in measurement of the ionization potential of the substance during use of the IE-06 ion source is ±0.1 eV. A controlled measurement was made of the ionization potential of Ag and the ionization potential of the molecules ThO and ThO_2 in vapor above ThO_2 were measured. (tr-auth)

22213 COLLECTOR VARIENT OF ROTOR COMPENSATED GAUGE FOR MAGNETIC FIELDS. Polevoi, R. M. (Inst. of Atomic Energy, Moscow). Prib. Tekh. Eksp., No. 1, 178-80 (Jan.-Feb. 1967). (In Russian).

An improved varient of the rotor compensating gage for the measurement of the topography of magnetic fields with precision of 10^{-4} in a wide range of the field intensity was described. The sensitivity of the device is 1.7×10^{-4} Oe and the recurrance of results is $\pm 3.5 \times 10^{-5}$ in fields of 6 Oe. Electric and kinetic designs of the device are given. The possibility of additional improvements was shown. (tr-auth)

21214 THERMOCOUPLE OF HIGH TEMPERATURES IN VACUUM. Pletenetskii, G. E. Prib. Tekh. Eksp., No. 1, 203-4(Jan.-Feb. 1967). (In Russian).

The results of the calibration of a W–Nb and Mo–Nb thermocouple were reported. The calibration was carried out in vacuum with residual pressure of 1×10^{-5} torr. The t.e.d.s. (thermoelectromotive force) of the W–Nb thermocouple at 2,000°C is 26.50 mV. The Mo–Nb thermocouple has the maximum value for t.e.d.s. = 22.24 mV at 1,800°C. (tr-auth)

22215 INVESTIGATION OF SINGLE FAST MOVING PROCESSES BY MEANS OF COMPENSATING ELECTRON SHUTTERS OF THE ELECTRON-OPTICAL CONVERTOR PIM-3. Davidenko, V. A.; Dolgoshein, B. A.; Somov, S. V. (Moscow Engineering-Physics Inst.). Prib. Tekh. Eksp., No. 1, 167-70(Jan.-Feb. 1967). (In Russian).

A method for the use of the electron shutter of the electron-optical converter PIM-3 used to photograph some subsequent represented fast moving processes, displaced in time approximately 10^{-10} sec, was described. (tr-auth)

22216 IN-PILE CALORIMETRIC DOSIMETRY. I. Ohno, Keiichi; Hayakawa, Sohachiro (Tokyo Inst. of Tech.). J. Nucl. Sci. Technol. (Tokyo), 3: 516-21(Dec. 1966).

An adiabatic calorimeter was designed for measuring energy absorbed in materials (C, Al, $(CH_2)_n$ and Pb) placed in the experimental hole of a nuclear reactor. Details are given of the apparatus and procedures of the calorimeter, followed by an account of the results of calibration and of dosimetry in the TRIGA II type reactor. The operating temperatures were 25–30°C at 100 kW reactor power, and the energy deposition (or dose) rate was 0.2 ~ 2mW/g. The performance was satisfactory in spite of the poor agreement between the observed and calculated rates of temperature rise. The ratio between energy absorption due to fast neutron scattering and that due to γ-rays obtained in the TRIGA II is consistent with the data obtained with BEPO. The experimental accuracy (standard error) at full reactor power is estimated to be within 2.1%. (auth)

22217 CRYSTALLINE SPECTROMETER FOR NEUTRON POLARIZATION. Michalec, Rudolf; Vavrin, Josef; Chalupa, Bohumil; Vavra, Jaroslav (Inst. of Nuclear Research, Czechoslovak Academy of Sciences, Rez). Jad. Energ., 12: 421-5(Nov. 1966). (In Czech).

A crystalline spectrometer for thermal and resonance neutron polarization is described. The device consists of a polarizer, magnetic tracer, analyzer, and electrical equipment. The light power, resolving power, neutron beam polarization, and polarization rotation efficiency are tested. (tr-auth)

22218 POSSIBILITY OF THE DETECTION OF A CONDUCTOR MOVEMENT IN A HOMOGENEOUS MAGNETIC FIELD. Novakovic, M. (Boris Kidric Inst. of Nuclear Sciences, Belgrade). J. Sci. Instrum., 44: 316(Apr. 1967).

A method for measurement of movement in a homogeneous magnetic field is proposed, based on electromagnetic induction in a moving conductor. It offers the possibility of measuring the "absolute" movement of the earth in an out-of-earth magnetic field, but it could also be developed as an "absolute" tachometer. (auth)

22219 DEPENDENCE OF THE SPHERICAL ABERRATION COEFFICIENTS OF A QUADRUPOLE LENS ON THE OBJECT DISTANCE (RECTANGULAR MODEL). Dymnikov, A. D.; Fishkova, T. Ya.; Yavor, S. Ya. Izv. Akad. Nauk SSSR, Ser. Fiz., 30: 739-41(May 1966). (In Russian).

Equations given elsewhere by the present authors (Dokl. AN SSSR, 162, 1265 (1965)) were employed to calculate, with the aid of a computer, the spherical aberrations of magnetic and electrostatic quadrupole lenses. Curves are presented showing each of the four spherical aberration coefficients of both types of quadrupole lens as functions of the object distance for different values of the excitation. The principal spherical aberration coefficient for the converging plane is always positive and has a minimum; the relation between excitation and object distance for the minimum value of this coefficient is presented graphically. The spherical aberration in the width of a linear image in the median plane for a magnetic quadrupole lens is compared with the corresponding quantity for an analogous axially symmetric lens; for equal object distances and focal lengths, the quadrupole lens has the smaller spherical aberration. (ATD)

22220 IMPROVEMENTS IN OR RELATING TO NUCLEAR PARTICLE BEAM APPARATUS. Davey, Cyril Norman (to United Kingdom Atomic Energy Authority). British Patent 1,063,216. Mar. 30, 1967. Filed July 19, 1963.

A beam scanner for determining the beam position in an accelerator is described. The scanner includes a probe arranged to oscillate through the beam transverse to the axis of the beam, the probe comprising a single conductor having two coplanar conducting portions both of which pass through the desired position of the beam as the probe oscillates and which as they pass the desired position of the beam are generally parallel to two directions at right angles

respectively, means to derive a current from the probe the magnitude of the current varying in dependence upon the position of the probe relative to the beam, and means to display variations in the magnitude of the current visually, the arrangement being such that the display shows the positions of the beam relative to said two directions. (B.G.D.)

22221 IMPROVED MEANS FOR STABILIZING ION BEAMS IN ION SOURCES, ACCELERATORS, MASS SPECTROMETERS AND THE LIKE. (to Atomic Energy Commission). British Patent 1,063,326. Mar. 30, 1967. Priority date Jan. 31, 1964, United States.

A device is described for reducing low-frequency rf signals in an ion beam which is magnetically oriented in an evacuated region defined by electrically conducting walls. (B.G.D.)

Radiation Effects on Instruments and Instrument Components

22222 (LA-3662) DECALIBRATION OF A TUNGSTEN–TUNGSTEN 25 PERCENT RHENIUM THERMOCOUPLE IN A NEUTRON FLUX. Skaggs, S. R.; Ranken, W. A.; Patrick, A. J. (Los Alamos Scientific Lab., N. Mex.). Jan. 1967. Contract W-7405-eng-36. 7p. Dep. mn. CFSTI $3.00 cy, $0.65 mn.

A determination was made of the change in thermoelectric emf of a W/W-25Re thermocouple resulting from irradiation at an average temperature of 2000°K for 5328 hr in a thermal flux of 2.0×10^{13} n/cm^2-sec for a total exposure of 3.8×10^{20} nvt. Comparison of the postirradiation thermoelectric output with that of an unirradiated thermocouple from the same batch showed that the thermal emf was increased by the combination of transmutation and phase separation due to irradiation at temperature. This change is noted over the entire range from room temperature to 2170°K. The difference in temperature required to generate the same thermal emf for the irradiated and unirradiated thermocouple varied from 60°K at 1200°K to 33°K at 2170°K. The lack of agreement of this measurement with investigations at General Electric Nuclear Materials and Propulsion Operation using simulated W–Re–Os alloys based on calculated compositions may be due to the separation observed in our experiment, of the W–Re leg into two phases, one of which contained a much higher relative proportion of osmium than the other. (auth)

22223 ANOMALOUS RADIATION EFFECT IN p-CHANNEL MOSFET'S UNDER ELECTRON IRRADIATION. Newman, Phillip A.; Wannemacher, Harry (Goddard Space Flight Center, Greenbelt, Md.). Proc. IEEE (Inst. Elec. Electron. Eng.), 55: 562(Apr. 1967).

An anomalous shift in the gate threshold voltage of high-transconductance p-channel MOSFET's has been observed during exposure to space-like radiation of 2×10^{12} electrons/cm^2 that is 2½ to 3 times its saturation value at 2×10^{14} electrons/cm^2 and is 5 to 7 times its pre-irradiation value. (auth)

22224 METHOD FOR MEASURING TRANSIENT PROCESSES IN SEMICONDUCTOR DEVICES ON A LINEAR ELECTRON ACCELERATOR. Mamedov, R. A.; Ukhin, N. A. Izv. Akad. Nauk. Azerbaidzh. SSR, Ser. Fiz.-Tekh. Mat. Nauk, No. 2, 68-73(1965). (In Russian).

It is assumed that semiconductor device is irradiated with a 0.6 μsec pulse of 30-MeV electrons from a linear accelerator. The resulting current is due to excess, nonequilibrium carriers created by ionization of the atoms in the material. The resorption of these carriers is followed on the assumption that the conductivity of the p-region is substantially greater than the conductivity of the n-region. It is assumed that the recombination of the carriers is an ordinary linear or monomolecular recombination. A differential equation involving the concentration of excess holes in the n-region, the coefficient of diffusion of the holes, and the lifetime of the holes in the n-region is written for the diffusion current. It is possible to estimate the lifetime of the excess carriers, the excess carrier concentration, and the transitory current pulse as a function of the total irradiation dose. (TTT)

22225 SURFACE EFFECTS OF RADIATION ON SEMICONDUCTOR DEVICES. Mitchell, J. P.; Wilson, D. K. Bell Syst. Tech. J., 46: 1-80(Jan. 1967).

The observed effects of ionizing radiation on nonpassivated, gas-filled transistors are interpreted in terms of a model in which ions formed in the gas ambient deposit charge on the device surface. The resultant surface charge buildup creates channels on the device surface which causes a decrease in H_{FE} and increase in I_{CBO}. Saturation, recovery, and the effects of dose rate and bias are also discussed. Degradation of planar passivated transistors and other devices employing SiO_2 layers due to irradiation is similar to that observed for nonpassivated devices. Surface charge buildup affects the device surface and leads to degradation. Most experimental evidence points to accumulation of positive charge at the SiO_2–Si interface as the cause of degradation. Several possible means of charge buildup at the interface are discussed. However, the process responsible has not, as yet, been identified. The direction of future experiments is discussed, particularly of those experiments which may yield information about the part played by radiation in positive charge accumulation at the SiO_2–Si interface. (BBB)

LIFE SCIENCES

Biochemistry, Physiology, and Molecular Biology

Refer also to abstracts 21858, 21891, 22365, 22379, 22470, 22652, 22654, and 22835.

22226 (ACRH–26, pp 33–5) EFFECT OF ERYTHROPOIETIN ON HUMAN BONE MARROW CELLS IN VITRO. Krantz, S. B. (Argonne Cancer Research Hospital, Chicago, Ill.).

The effect of erythropoietin on heme synthesis by human bone marrow cells in tissue culture is described. It is concluded that the cell culture system for human bone marrow that is described can be used to study human erythrocyte diseases. (C.H.)

22227 (ACRH–26, pp 65–9) ESTROGEN PHARMACOLOGY. III. THE EFFECT OF ESTRADIOL ON THE PLASMA DISAPPEARANCE RATE OF BSP IN MAN. Kottra, L. L.; Kappas, A. (Argonne Cancer Research Hospital, Chicago, Ill.).

Sulfobromophthalein (BSP) components in the plasma of estrogen treated patients were analyzed at appropriate intervals after intravenous injection of the dye. The results indicate that the net movement of both free and conjugated BSP out of the bloodstream, and subsequent hepatic uptake, is significantly decreased by estrogen treatment. (C.H.)

22228 (ACRH–26, pp 70–84) PRODUCTION OF BILE DUCT HYPERPLASIA AND GALLSTONES BY LITHOCHOLIC ACID. Palmer, R. H.; Hruban, Z. (Argonne Cancer Research Hospital, Chicago, Ill.).

The acute and chronic effects of lithocholic acid, a metabolite of cholesterol, were investigated in rats. Feeding large amounts of lithocholic acid resulted in bile duct hyperplasia and the formation of gallstones. Livers of rats fed lithocholic acid or sodium lithocholate in both acute and chronic experiments showed microscopic changes that were essentially similar and limited to the bilary system. Lithocholic acid-24-^{14}C was injected intraperitoneally and the effects of various dietary alterations on the metabolism of lithocholic acid in rats were studied. (C.H.)

22229 (ACRH–26, pp 85–94) RNA THIOLASE: THE ENZYMATIC TRANSFER OF SULFUR FROM CYSTEINE TO sRNA IN ESCHERICHIA COLI EXTRACTS. Hayward, R. S.; Weiss, S. B. (Argonne Cancer Research Hospital, Chicago, Ill.).

Reaction mechanisms involved in the enzymatic transfer of sulfur from cysteine to sRNA in Escherichia coli extracts were studied using ^{35}S-cystine, reduced to cysteine, as a tracer. Results showed that E. coli extracts will catalyze the transfer of S from cysteine to RNA, and that this transfer requires ATP, a divalent metal ion, and RNA derived from soluble cell extracts. (C.H.)

22230 (ACRH–26, pp 95–105) THE INFLUENCE OF POLYCYCLIC AROMATIC HYDROCARBONS ON BACTERIOPHAGE DEVELOPMENT. II. Hsu, W.-T.; Moohr, J. W.; Tsai, A. Y. M.; Weiss, S. B. (Argonne Cancer Research Hospital, Chicago, Ill.).

A method is described for preparing infected spheroplasts from Escherichia coli cells preinfected with phage. The method was used to determine the effects of polycyclic aromatic hydrocarbons on the replication of both single- and double-stranded viruses. Results showed that certain aromatics strongly inhibit virus production while others have little or no effects. (C.H.)

22231 (ACRH–26, pp 106–14) THE EFFECT OF TRYPSIN ON ESCHERICHIA COLI AND RABBIT RETICULOCYTE RIBOSOMES. Zak, R.; Nair, K. G.; Rabinowitz, M. (Argonne Cancer Research Hospital, Chicago, Ill.).

Results are reported from a series of studies on the effect of trypsin on ribosomes of Escherichia coli and rabbit reticulocytes. Neither trypsin inhibitor nor trypsin caused a change in ribosome function in the systems studied. No ribonuclease activity was detected in the trypsin. (C.H.)

22232 (BMwF-FBK–66–36) UNTERSUCHUNGEN AN NUCLEOHISTONEN. (Investigations on Nucleohistones). Harbers, E. (Bundesforschungsanstalt fuer Wissenschaftliche Forschung, Bad Godesberg (West Germany)). Nov. 1966. 14p. (In German). Dep. mn.

After a short introduction to the need for information on somatic cells, various methodical investigations of the isolation of nucleohistones and their fractionation into euchromatin and heterochromatin are reported. In model experiments with nucleohistones isolated from Ehrlich ascites tumor cells, x rays caused a decrease in the template activity for RNA-polymerase; pure DNA was found to have a higher radiosensitivity. Studies with labeled actinomycin showed that the ratio of bound actinomycin per DNA was considerably higher in euchromatin as compared to heterochromatin. In tumor cells the portion of euchromatin was lower than in normal tissues; tumor induction in the rat liver by diethylnitrosamine also caused a decrease in the amount of euchromatin. These observations discussed with respect to the problem of carcinogenesis. (auth)

22233 (BNL–994, pp 113–23) BIOLOGY. (Brookhaven National Lab., Upton, N. Y.).

The report provides brief summaries of progress in the areas of plant science: ecology classification of genetic systems by chromosomal and radiobiological parameters, reproductive integrity of somatic cells of Tradescantia after acute γ-irradiation, genetic variation at the protein level in tobacco and wheat, tumors in interspecific hybrids of Nicotiana, and genetic recombination of waxy mutants induced in maize by ethyl methanesulfonate; plant physiology: photoperiodism and photomorphogenesis, structure and function of microtubules, plant bile pigments, photophosphorylation in spinach chloroplasts, and bacteriochlorophyll-protein complex of green photosynthetic bacteria; general physiology: radiation induced aging, injury and recovery in the intestinal tract following irradiation, mechanism of action of insulin, porphyrin compartments in duck erythrocytes, and material-membrane transfer; and molecular biology: genetic transformation of Pneumococcus, genetic determination of protein primary structure with Salmonella typhimurium, source of T7 bacteriophage DNA, intracellular development of bacteriophage ΦX174, pancreatic enzymes, structure and function of enzymes, protein structure, and determination of macromolecular structure by x-ray diffraction. (B.H.S.)

22234 (COO–1156–21) ^{137}Cs IN SOME COLORADO GAME FISH, 1965–66. Nelson, Wesley C. (Colorado Dept. of Game, Fish, and Parks); Whicker, F. Ward (Colorado State Univ., Fort Collins. Dept. of Radiology and Radiation Biology). Jan. 1967. Contract AT(11-1)-1156. 23p. (CONF-670503-1). Dep. mn. CFSTI $3.00 cy, $0.65 mn.

For Presentation at 2nd National Symposium on Radioecology, Ann Arbor, Mich.

In 1965 and 1966 the ^{137}Cs concentration in muscle tissue of 132 fish representing eight game fish species from 23 Colorado waters varied from non-detectable (<50 pCi/kgm) to 5,800 pCi/kgm. Waters sampled included 3 plains, 2 foothills, 5 montane, and 12 alpine reservoirs and lakes as well as one trout stream. Elevation of these waters varied from 1,538 to 3,498 meters. Lake depths varied from 1 to 45 meters, lake areas from 1.4 to 230 hectares and lake watershed areas, where measured, from 52 or 53 to 480 hectares. Conductivity of waters varied from 8 to 1,390 micromhos and potassium concentration from 0.1 to 3.1 ppM. Based on 6 samples, ^{137}Cs concentrations were from 2 to 7 times greater in 1965 than 1966. In general sunfish, crappies, and trout sampled from plains and foothills reservoirs and lakes and the river contained little or no ^{137}Cs. Trout and salmon from a montane reservoir and one lake had low or moderate concentrations of ^{137}Cs, whereas those from another montane lake had high concentrations of ^{137}Cs. Trout from alpine lakes and reservoirs had moderate to high concentrations of ^{137}Cs. Variations in ^{137}Cs concentrations in fish from different types of waters are ascribed to differences in ^{137}Cs input as well as to limnological characteristics. Variations in ^{137}Cs concentrations between species are ascribed to differences in the biology and physiology of the species. (auth)

22235 (EUR–2526.f) ALTERATIONS QUALITATIVES DES PLAQUETTES APRES IRRADIATION. RAPPORT FINAL. (Qualitative Alternations in Platelets after Irradiation. Final Report). Bernard, J.; Caen, J. (Paris Univ. (France)). 1965. 58p. (In French). Dep. mn.

In vitro irradiation at doses of 50 to 800 rads of platelet-rich citrated human plasma slows down the spreading of the platelets on the glass and causes a lysis of certain thrombocytes as well as a hypercoagulability of the platelets measured by microscopy and photometry. This hypercoagulability is not a function of the doses applied, but is accompanied by a reduced liberation of coagulating activity by the platelets in the presence of thrombine. There is no modification of the phosphohydrolase enzyme activity either of the irradiated plasmas or platelets. However, analysis of the energy-rich nucleotides shows an increase in DPA relative to MPA which is more pronounced in the plasma than the platelets. The authors construe this variation as the reason for the hypercoagulability of the platelets. Furthermore, they observed no anomaly on the part of the platelet phospholipides, the antihaemophitic plasma factor A or fibrinogen after irradiation.

The exposure of wistar rats to doses of 600 rads gives rise, before the thrombopenia stage, to a statistical increase in the bleeding time and, paradoxically enough, from the very first day after the irradiation to a platelet hypercoagulability which has been linked to the impaired capacity of irradiated rats' plasma to degrade extrinsic DPA. (auth)

22236 (EUR-2959.e) STUDIES ON DNA REPLICATION IN ANIMAL CELLS. Annual Report. Paoletti, C.; Dutheillet-Lamonthezie, N.; Jeanteur, Ph.; Obrenovitch, A. (Institut Gustave Roussy, Villejuif (France)). Aug. 1966. Contract 042-64-10 BIOF. 18p. Dep. mn.

Ehrlich and Krebs ascites cells DNA is pulse labelled by ^{3}H-thymidine in vivo and extracted at various times between 5 minutes and 7 hours after this pulse; radioactive material of the 5 min. DNA displays, when compared to bulk DNA, a higher affinity to MAK columns, a slower sedimentation rate and an increased sensitivity to alkaline denaturation without any change in CsCl and Cs_2SO_4 buoyant density. In DNA extracted longer after this pulse, the part of radioactive material which shows up such characteristics becomes progressively less important and in 2 hours DNA the behavior of labelled material and bulk DNA is nearly identical. The best explanation of these data is the existence of structurally modified DNA, correlated to its replication. (auth)

22237 (FOA-04-4485-4623) STUDIES ON PLANT ACCUMULATION OF FISSION PRODUCTS UNDER SWEDISH CONDITIONS. VII. PLANT ABSORPTION OF ^{90}Sr AND ^{137}Cs FROM SOIL AS INFLUENCED BY SOIL ORGANIC MATTER. Fredriksson, L.; Eriksson, A. (Forsvarets Forskningsanstalt, Stockholm (Sweden)). July 1966. 26p. DTIE.

The influence of soil organic matter on the mobility and plant availability of ^{90}Sr and ^{137}Cs has been studied in laboratory and pot experiments. A field survey of the content of ^{137}Cs in hay from soils differing in content of organic matter has also been performed. It was found that the mobility and plant availability of ^{90}Sr was only slightly influenced by the content of organic matter in the soil. The most important soil factor influencing plant uptake of ^{90}Sr was found to be the content of exchangeable calcium. Plant uptake of ^{137}Cs is, however, very dependent on the content of organic matter in the soil as it increases with increasing content of such matter. Two other soil factors of major importance for plant absorption of ^{137}Cs are the content of clay and potassium. Increasing content of K_{HCl} (or micaceous clay) means increased adsorption of ^{137}Cs in the soil and thus lowered plant availability. As K and Cs exert antagonistic effects on each other when absorbed by the plants, increased content of easily soluble K in the soil also depressed plant absorption of ^{137}Cs. The overall results of the investigation show that under the conditions prevailing in Sweden in the summer of 1963 from 3 to 25 per cent—depending on soil type—of the ^{137}Cs found in hay originated from deposits in the soil while from 75 to 97 per cent was collected by direct uptake or adsorption from the atmosphere. It is estimated that from 15 to 30 per cent of the amount of ^{137}Cs deposited as fallout during the time period April–June was retained by ley vegetation rich in grasses. (auth)

22238 (NP-16547) ANNUAL REPORT, JANUARY 1, 1965–DECEMBER 31, 1965. (Middle Eastern Regional Radioisotope Centre for the Arab Countries, Cairo (Egypt)). Jan. 1966. 38p. Dep. mn.

Activities in the training of specialists in the application of radioisotopes in science, industry, agriculture, and medicine and in research using radioisotope techniques are reported. Hydrochemical investigations of underground water were carried out in the United Arab Republic, Libya, and the Sudan. Sodium-22 was used to determine the exchangeable Na and the soil cation exchange capacity in soils. Tracer techniques were also used to study nitrogen and phosphorus uptake by plants growing on various soils and in water-use efficiency studies. Progress on eradication of Anopheles pharoensis and Ceratitis capitata by radiosterilization techniques is reported. Medical studies during the report period were concerned with ancylostomiasis, bilharziosis, and iodine metabolism in endemic goiter. A list of 29 references to papers published on work performed at the center is included. (H.G.D.)

22239 (NYO-2147-12) FISSION PRODUCT METABOLISM AND RESPONSE IN LABORATORY AND DOMESTIC ANIMALS AND PLANNING STUDY FOR EVALUATION OF RADIOACTIVE CONTAMINATION OF THE FOOD CHAIN. Progress Report, January 1, 1966–December 31, 1966. Comar, C. L.; (and others) (New York State Veterinary Coll., Ithaca, N. Y. Dept. of Physical Biology). Contract AT(30-1)-2147. 187p. Dep. mn. CFSTI $3.00 cy, $0.65 mn.

Evaluations of the levels of certain fissile and fission products in the food chain; investigations of factors that govern the movement of certain fission products in the food chain; studies of the fundamental physiological processes that determine the level of fission products that will occur in the human population; estimations of radiation dosages to tissues from ingested radionuclides and from external radiation; studies of effects of radiation including neurophysiological and behavioral responses; studies of transport of materials across biological membranes; and applications of radiation and radioisotopes to research on diseases of animals were carried out. Major emphasis was placed on research concerned with the alkaline earth metals, particularly calcium and strontium. These studies centered upon: the use of the atomic absorption spectrophotometer and the long-term feeding of diets enriched in stable strontium to determine long-term strontium-calcium behavior under essentially normal conditions; the role of magnesium in strontium-calcium metabolism; strontium-calcium relationships in hair as a possible basis for monitoring; and the isolation and characterization of a calcium-binding protein that appears to be involved in alkaline earth transport. An example of the application of data collected over previous years to a specific practical problem is represented by the development of equations that predict the total intake commitment for the human population of ^{137}Cs from milk following a single short-term contaminating event; in addition, methods are given for predicting the effects of practical countermeasures. Iodine-131 transport in the mammary gland with comparisons made to similar transport in the thyroid was investigated. A report of experiments on the breakage frequency and repair rates of chromosomes in the somatic and reproductive tissues of the Chinese hamster following external whole-body gamma irradiation is presented. Work utilizing the whole-body counter to study blood loss and parasitism in domestic animals and the gastro-intestinal absorption of various forms of iron including heme compounds was carried out and the results are presented in summary form. An assessment of the role of radioactive contamination in the food chain and man was studied. Emphasis was placed on development of alternative methods of estimating dietary ^{90}Sr and body burdens of ^{137}Cs; ^{131}I contributions from fruits and vegetables; mathematical models for prediction of radionuclides in milk utilizing climatological data; assessment of world-wide levels of ^{90}Sr and ^{137}Cs; and updating of food consumption data as related to radionuclide intake. (B.H.S.)

22240 (NYO-3240-17) THE EFFECT OF IRRADIATION ON THE MORPHOLOGICAL AND BIOCHEMICAL CHANGES ACCOMPANYING PHAGOCYTOSIS BY LEUKOCYTIC CELLS. Progress Report, June 1966–March 1967. Sbarra, Anthony J. (Saint Margaret's Hospital, Boston, Mass.). Contract AT(30-1)-3240. 33p. Dep. mn. CFSTI $3.00 cy, $0.65 mn.

Progress is reported on the following studies: radiation effects on bactericidal activity of phagocytes; effects of cysteine and glutathione on phagocytosis; effects of x radiation on pathway of glucose oxidation; effects of pH, catalase, and hydrogen peroxide on phagocytosis. (H.L.W.)

22241 (ORO-3546-3) INFLUENCE OF THE PHYSICAL STATE OF CHROMATIN ON NUCLEIC ACID AND PROTEIN SYNTHESIS AND ON RADIATION SENSITIVITY OF CELL DIVISION. Progress Report. Gaulden, Mary Esther (Texas Univ., Dallas. Southwestern Medical School). Feb. 24, 1967. Contract AT(40-1)-3546. 12p. Dep. mn. CFSTI $3.00 cy, $0.65 mn.

Eggs of grasshoppers (Chortophaga) were subjected to temperatures of 3 to 4°C; embryonic growth was stopped, and after 6 months of storage the eggs failed to hatch. New techniques for making serial paraffin sections of grasshopper embryos and techniques for making autoradiographs of tritiated thymidine labeled chromosomes of neuroblast cells were developed. The degree of expansion of condensation of the chromosomes in relation to DNA synthesis is discussed. The effects of colchicine on RNA metabolism are being studied. Immunological studies on rapidly dividing neuroblast cells are being conducted. (H.L.W.)

22242 (UCRL-17200) THE GEOMETRY AND ELECTRONIC STRUCTURE OF BIOLOGICALLY SIGNIFICANT MOLECULES AS OBSERVED BY NATURAL AND MAGNETIC OPTICAL ACTIVITY. I. PROTEIN CONFORMATION AND PLASTICITY. II. CHLOROPHYLL–CHLOROPHYLL INTERACTIONS. III. ELECTRONIC STRUCTURE OF METAL PORPHYRINS. Dratz, Edward Alexander (California Univ., Berkeley. Lawrence Radiation Lab.). Sept. 1966. Contract W-7405-eng-48. 316p. Dep. mn. CFSTI $3.00 cy, $0.65 mn.

Thesis.

Differences in the ultraviolet optical rotatory dispersion of the allosteric enzyme aspartate transcarbamylase, produced by effectors that alter its catalytic activity, appeared to reflect structural changes in the protein. These alterations of catalytic activity in response to the effectors, substrates, and inhibitors served an important metabolic control function in the cell. The conformational changes detected seemed to be related to the operation of

the control function and may be important for an understanding of the mechanism of activity control in the enzyme. The observed changes were small but significant and were interpreted as a 5% decrease in helix content upon maximal activation of the enzyme by substrate. No substrate or inhibitor induced structural modifications were detected in deoxycytidine monophosphate deaminase or in carboxydismutase. By the criteria of the measurements, the oxidized and the reduced forms of ceruloplasmin were observed to have identical conformation.The state of aggregation of chlorophylls in solution, in crystals and in photosynthetic particles is discussed. Evidence derived from circular dichroism (CD) and absorption spectra was used to propose a structure for the dimer of chlorophyll formed in nonbasic organic solvents. Chlorophyll a, chlorophyll b, and bacteriochlorophyll in vitro appeared to form dimers of similar structure under the conditions investigated. Aggregated chlorophyll exhibited a characteristically shaped, double CD spectrum in the long wavelength absorption band. The CD spectra of photosynthetic membrane fractions isolated from higher plants and photosynthetic bacteria suggested that some of the in vivo chlorophyll was aggregated. Investigations of membrane lamellae isolated from a mutant barley that contained no chlorophyll b revealed that chlorophyll a—chlorophyll a interactions were essentially independent of the presence of chlorophyll b, and that chlorophyll b—chlorophyll b interactions were present in the lamellae of normal barley. The CD spectrometer constructed for these measurements is described. The range of the instrument extended from 220 to 1200 millimicrons. Multiple spectrum averaging increased the ultimate sensitivity of CD measurements to 10^{-6} optical density units. A study of the magnetic circular dichroism (MCD) of porphyrins is presented. The physical basis of MCD is explained by a simple classical derivation. A semiclassical two-state model was developed to describe MCD quantitatively and to treat the influence of electron spin. The polarization of the electronic transitions in metal free protoporphyrin was assigned from the MCD spectrum. The MCD and absorption properties of zinc(II) porphyrins approached those expected for a free electron in a circular box. The magnetic field splits orbitally degenerated porphyrin excited states: For the zinc porphyrins, an orbital angular momentum of 6.5 was found in the lowest energy absorption band and 0.8 in the Soret band, whereas 9 and 1 were predicted by the free electron model. There was a more pronounced departure from the free electron model for other transition metal porphyrins. The orbital angular momenta of the lowest energy bands were: copper(II), 6.0; silver(II), 5.3; nickel(II), 4.7; cobalt(II), 4.6; and iron(II), 4.0. A detailed interpretation of the metal porphyrin MCD was accomplished by the use of molecular orbital theory. MCD experiments on iron porphyrins and heme proteins indicated that the magnetic orbital splitting was sensitive to ligand coordination above and below the iron porphyrin plane. A brief evaluation of the possible future usefulness of MCD in chemistry and biology is included. (auth)

22243 (UCRL-50168) SURVEY OF THE RESPONSES OF RAT-LIVER MITOCHONDRIA TO SIMPLE METAL CATIONS. Grabske, Robert (California Univ., Livermore. Lawrence Radiation Lab.). Dec. 29, 1966. Contract W-7405-eng-48. 20p. Dep. mn. CFSTI $3.00 cy, $0.65 mn.

Isolated rat-liver mitochondria, incubated in a medium containing succinate, inorganic phosphate, KCl, and tris, were exposed to 50 different metal cations. Recordings were made of changes in respiration, pH, and light scattering in response to the added metal ions. The ions tested were classed as respiratory stimulators, respiratory inhibitors, and inducers of mitochondrial swelling. The response to barium was qualitatively similar to the responses to calcium, strontium, and manganese and indicated that barium may be actively transported by rat-liver mitochondria by a mechanism similar to the well-known transport systems of calcium, strontium, and manganese. Copper, silver, gold, zinc, cadmium, and mercury all induced mitochondrial swelling and, with the exception of gold, inhibited respiration. Copper, silver, and cadmium, however, briefly stimulated respiration prior to its ultimate inhibition. The elements of the lanthanide series induced a slight amount of swelling, but did not affect respiration. Of the 50 ions tested, 23 were apparently inert. (auth)

22244 EFFECTS OF RADIATION ON KINETIN SOLUTIONS. Belli-Donini, M. L.; Cervigny, T. (CNEN, Rome). Nature, 214: 468-70(Apr. 29, 1967).

When the plant hormone kinetin is x-irradiated it decomposes to an extent depending on the exposure. Ultra-violet spectrophotometry and chromatography indicate that the chief degradation compounds are adenine, hypoxanthine and a substance with an R_F value of 0.28. (auth)

22245 EFFECT OF X-IRRADIATION ON THE SYNTHESIS AND COMPOSITION OF PULSE-LABELED RNA OF THE LIVER OF THE RAT FOETUS. Simic, M. M.; Hudnik-Plevnik, T.; Kanazir, D. T. (Boris Kidric Inst. of Nuclear Sciences, Belgrade). Nature, 214: 489-90(Apr. 29, 1967).

It was found in earlier studies that when rat embryos were irradiated on the 9th day of embryonic development, or during early organogenesis, the growth rate of the liver decreased between the 15th and 21st days of embryogenesis. The slower growth at this stage of development was followed by a decrease of nucleic acid and protein contents. In this studies described the effect of irradiation (X-) on the synthesis and base composition of pulse-labeled RNA in rat foetuses at the 15th day of embryogenesis, after irradiation on the 9th day of embryonic development, was investigated. This RNA fraction was chosen since it is a direct product of DNA transcription and composed of mRNA and tRNA precursors. These two fractions are essential for protein synthesis. The investigation was based on the assumption that any damage induced by irradiation in the DNA structure would be transcribed into pulse-labeled RNA and translated to the composition of the protein molecules. The metabolism of the pulse-labeled RNA was investigated by injection of ^{32}P into the peritoneum of a pregnant female rat. The nucleotide composition of the pulse-labeled RNA was determined by the distribution of 2′- and 3′-nucleotide-^{32}P separated by paper electrophoresis. The sedimentation patterns of RNA extracted from livers of unirradiated and irradiated 15-day foetuses are shown graphically. Incorporation of ^{32}P was higher in all fractions of the liver of irradiated foetuses. Results are discussed. They suggest that after x irradiation the transformation of the precursor rRNA into a stable fraction of rRNA is disturbed, that is, the transformation of preribosomes into ribosomes is probably disturbed. (UK)

22246 EFFECT OF PARATHYROID HORMONE AND VITAMIN A ON THE RETENTION OF RADIOSTRONTIUM IN THE RAT. Spreng, P. (Institut fuer Strahlenbiologie, Karlsrule, Ger.). Nature, 214: 513-14(Apr. 29, 1967).

Experimental data on the influence of parathyroid hormone on the excretion of radiostrontium are ambiguous, some studies reporting no effect, other studies reporting diminished or enhanced retention. These discrepancies may be accounted for in a number of ways. Results indicating a positive influence were obtained measuring only urinary excretion. Furthermore, the capacity of commercial preparations of the hormone to mobilize calcium from the bone may vary. Finally, in most studies the hormone was administered a comparatively short time after incorporation of radiostrontium. Experiments using ^{45}Ca indicate that the hormone influences calcium in the deeper bone areas. It follows that time of administration may affect experimental results. The effect of vitamin A on retention of radiostrontium was also studied, employing ^{85}Sr as chloride injected into rats, and investigating the retention by whole body counting using a plastic scintillator. Retention of ^{85}Sr incontrol animals could be represented by the sum of several exponentials. The amount of calcium in the 24 hour urine of control animals was 0.794 ± 0.044 mg; a single dose of the hormone or vitamin increased excretion to 1.65 ± 0.083 or 1.07 ± 0.092 mg, respectively. A significantly lower burden of ^{85}Sr was observed only when hormone administration was commenced on the 27th or 47th day. The effect of vitamin A, however, was independent of time, indicating a different mode of action. (UK)

22247 ACTIVITY OF l-AMINO-ACID-OXIDASE AND ACYL-CoA-DEHYDROGENASE IN MITOCHONDRIA AND CONTENT OF FLAVINE-ADENINE-DINUCLEOTIDES IN LIVER AND SPLEEN OF RATS IRRADIATED IN VIVO. Waldschmidt, Marianne (Univ., Freiburg i. B.). Strahlentherapie, 132: 463-71(Mar. 1967). (In German).

The activity of l-amino-acid-oxidase in spleen mitochondria is always distinctly decreased 2 to 40 hours after in vivo irradiation with 300 R. The specific activity of the Butyryl-CoA-dehydrogenase was increased in spleen and thymus mitochondria 8 hours after irradiation, the activity of the total organ was about constant. The activity of the dehydration of Palmitoyl-CoA was distinctly reduced in spleen mitochondria between 8 and 16 hours after irradiation. The activity of all mentioned enzymes in liver mitochondria, the oxidation of ^{14}C-Palmitate to $^{14}CO_2$ by liver and thymus mitochondria, and the FAD content in liver and spleen were not affected by the irradiation. (auth)

22248 EFFECT OF 2-AMINOETHYLISOTHIURONIUM BROMIDE HYDROBROMIDE ON THE ^{22}Na TRANSPORT IN ISOLATED SMALL INTESTINE OF NORMAL AND IRRADIATED RATS. Phan Van Duyet; Nejtek, Vilem M.; Dienstbier, Zdenek (Charles Univ., Prague). Strahlentherapie, 132: 448-53(Mar. 1967). (In German).

2-Aminoethylisothiuroniumbromide-hydrobromide (AET), used in in vitro experiments in a concentration of 150 μg/ml of the incubation medium, causes an increase in ^{22}Na-transport and a decrease in ^{22}Na-incorporation in isolated small intestine of normal (non-irradiated) rats. This direct and local effect of AET is

probably due to the changes in the membrane permeability for the Na-ion. Sodium-22 transport in the small intestine is decreased and the incorporation into the intestinal wall is increased in normal (non-irradiated) rats 15 min after intraperitoneal administration of AET in a concentration of 150 μg/g body weight. In this case, there is not only the direct local effect, but also the indirect effect of AET upon the intestine, which is caused by circulatory and respiratory disturbances. ^{22}Na-transport and ^{22}Na-incorporation return to normal values within 48 hours after administration of AET. The same dose of AET, administered 15 min prior to irradiation (800 R), results in normal ^{22}Na-transport within 48 hours, but does not inhibit the incorporation of ^{22}Na into the intestinal wall, which is increased due to the irradiation. (auth)

22249 QUANTUM-CHEMISTRY THEORY OF PRIMARY RADIATION EFFECTS. Barany, Janos. Strahlentherapie, 132: 399-408(Mar. 1967). (In German).

The primary biological radiation effect is considered to be the ejection of an electron from a molecule by an incident photon or corpuscle. The dissociation of a water molecule changes the physical environment of the solvent of the cell. The chemically active fractions of the other molecules can result in foreign molecules within the multi-phasic solution of the cell. The foreign, atypical protein molecules disturb the cell metabolism resulting in an early cell death. The subsequent changes in the tissues are also discussed and the energy balance considered. (auth)

22250 ROLE OF THE THYMUS IN PHAGOCYTIC FUNCTIONS OF THE RETICULO-ENDOTHELIAL SYSTEM. Fridrich, Raimund (Univ., Basel). Strahlentherapie, 132: 421-8(Mar. 1967). (In German).

A temporary disturbance in the phagocytosis activity of the RES was observed in adult mice after thymectomy. Regulatory mechanisms which resulted in the normalization of the radiogold phagocytosis started relatively fast. Additional immunosuppression caused by thymectomy and whole body irradiation with 350 R or by treatment with 3 × 250 mg/kg of methylhydrazine did not result in a greater disturbance of the phagocytosis activity than the one caused by thymectomy only. Present experimental results permit the preliminary conclusion that the phagocytosis activity of the RES seems to depend upon the thymus, a dependability which, in contrast to the corresponding relationship to the immune reactions, is also effective in the adult organism. (auth)

22251 LIPOID CHANGES IN VARIOUS ORGANS OF THE RAT AFTER LETHAL WHOLE-BODY X IRRADIATION. IV. COMPOSITION OF LIVER PHOSPHATIDES. Eberhagen, Dietrich; Remler, Ute (Univ., Munich). Strahlentherapie, 132: 441-7(Mar. 1967). (In German).

The composition of liver phosphatides was investigated in whole body irradiated rats (1500 R) at different times after radiation exposure by means of thin layer chromatography. A decrease of the Lecithin- and Colaminkephalin fractions (rich in polyene fatty acids) was found 6 to 12 hours after exposure. Later on, the values were normal until the death of the animals which occurred about 60 hours after irradiation. (auth)

22252 CHEMICAL SEPARATION OF ^{90}Sr IN THE HUMAN BONE ASH. Koritsanszky, Denes. Magyar Radiol., 18: 373-7 (Dec. 1966). (In Hungarian).

The method of separation of the Sr-90 content in the bone-ash 55 human individuals for measurement is described in detail. This method is simpler and easier to carry out than the methods known up to the present, with less sources of error. As to the main values, the results obtained with this method correspond to those of other procedures. (tr-auth)

22253 FRAGMENTARY TRANSFER OF ^{32}P LABELED PARENTAL DNA TO PROGENY PHAGE III. INCORPORATION OF A SINGLE PARENTAL FRAGMENT TO THE PROGENY MOLECULE. Shahn, Ezra (Hunter Coll., New York); Kozinski, Andrzej. Virology, 30: 455-70(Nov. 1966).

Two independent experiments are reported that indicated that parental contribution was continuous and that parental DNA contributions to progeny T4 phages resided in one subunit. In one, DNA from heavy (5-bromodeoxyuridine substituted) progeny derived from light (normal density) parental phages was sheared into half and quarter molecules; analysis in CsCl revealed these fragments to have 2 and 4 times the relative parental contribution of the unsheared progeny DNA. In the other experiment, light parental phages labeled with large amounts of ^{32}P were used to infect heavy bacteria. The size of the parental density moiety of denatured progeny DNA as a function of accumulated ^{32}P scissions agreed with the calculation that assumes the parental contribution to be in one piece. Thus, when phage grown in medium of high ^{32}P sp act. (100 to 300 mC; ^{32}P/mg P) were stored in liquid nitrogen and titrated every few days, it was observed that the plaque-forming ability decreased exponentially with the number of decayed ^{32}P atoms; about 10 disintegrations corresponded to one hit. When a progeny population was prepared from these suicidal phage before any appreciable decay could occur, the result was phage whose parental contribution was very rich in ^{32}P. Each ^{32}P disintegration caused a break in the continuity of the polynucleotide chain of which it was a part: two such breaks thus resulted in a small piece of single-stranded DNA that was kept in place by hydrogen bonding to its complementary strand and that could be liberated from the rest of the molecule by denaturation. The density of this piece was determined by analysis in a CsCl density gradient. A mode of recombination involving multiple exchanges between partners was excluded by these results. (BBB)

22254 THE EFFECT OF FATTY ACID FRACTION FROM THE LIVER OF X-RAY IRRADIATED RABBITS ON THE RESPIRATION OF A MICROORGANISM: A STUDY ON THE RESPIRATION OF SACCHAROMYCES CARLSBERGENSIS. Yamamoto, Goki (Okayama Univ. Medical School, Japan). Nippon Igaku Hoshasen Gakki Zasshi, 23: 778-85(Sept. 25, 1963).

As previously shown, a fatty acid fraction (OX) extracted from the liver of whole-body x-irradiated rabbits inhibited the proliferation of Saccharomyces carlsbergensis. The proliferation of the yeast was inhibited by addition of OX to Sabouraud's medium containing glucose under aerobic conditions and was more strongly inhibited by OX in this medium under anaerobic conditions. Lipid containing a double bond was required for the anaerobic proliferation of the Saccharomyces and this proliferation was inhibited by addition of OX containing unsaturated fatty acids. These data suggested that OX acted as an inhibitor in the lipid metabolism of Saccharomyces. In aerobiosis, OX, lecithin, linoleic acid, and glucose were utilized as substrates for respiration of the cells; utilization of glucose was the most effective. In anaerobiosis, glucose and lecithin were utilized as substrates, and carbon dioxide production was observed, but with OX and linoleic acid it was not observed. Respiration of the cells in the presence of glucose as a substrate in aerobiosis and anaerobiosis was increased by addition of lecithin and linoleic acid, but was inhibited by addition of OX. In aerobiosis and anaerobiosis OX had an inhibitory action on the respiration of the cells when glucose and lecithin served as substrates. No inhibitory action was observed with linoleic acid. Thus OX has a different action from linoleic acid on the metabolism of Saccharomyces. (BBB)

22255 SYNTHESIS OF RIBONUCLEIC ACID IN THE REGENERATING LIVER OF THE RAT AND ITS SENSITIVITY TO TOTAL-BODY IRRADIATION. Berg, T. L.; Goutier, R. (Centre d'Etude de l'Energie Nucleaire, Mol, Belg.). Arch. Int. Physiol. Biochim., 74: 909-11(1966). (In French).

In partially hepatectomized rats the sp act. of nuclear RNA of liver reached a maximum 25 and 45 min after intravenous injection of ^{14}C-orotate at 12 and 15 hr, respectively, after operation. The sp act. of cytoplasmic RNA, in contrast, increased regularly and more slowly. Irradiation of the rats with a single 1000-R, whole-body dose of x rays 1 hr before partial hepatectomy caused a drop in sp act. which was more marked for cytoplasmic than nuclear RNA. If it is accepted that cytoplasmic RNA is synthesized in the nucleus, the inhibition of nuclear RNA synthesis is more pronounced than is evident from its sp act. Short-term (10 min) ^{14}C-orotate labeling is thus more indicative of the nuclear RNA synthesis rate than longer term labeling (45 min). During the first 18 hr after partial hepatectomy, nuclear RNA synthesis no longer increased in irradiated animals, although that of cytoplasmic RNA increased, but more slowly than in controls. Analysis of purified RNA by sucrose-density gradients in the ultracentrifuge revealed that 4S RNA was of the normal composition of nuclear RNA and not contaminated with cytoplasmic RNA. It also showed that irradiation inhibited labeling of the heavy nuclear fractions, since the inhibition of labeling of cytoplasmic RNA was generally not accompanied by changes in the relative distribution of radioactivity. Thus the synthesis of nuclear RNA is inhibited by irradiation but to a lesser extent than that of DNA in the regenerating liver. (BBB)

22256 INFLUENCE OF GRAZING INTENSITY ON RADIOSTRONTIUM CONCENTRATIONS IN MILK. Burmann, Franz J. (Robert A. Taft Sanitary Engineering Center, Cincinnati); Fries, George F.; Anderson, Melvin J.; Stoddard, George E. J. Dairy Sci., 49: 1219-22(Oct. 1966).

The effect of grazing intensity on radiostrontium concentrations in milk was studied by comparing milk of two groups of Holstein cows grazed rotationally. One group on a normal rotational grazing system followed the second group one plot behind. Milk samples from the second group following the first one showed a significant increase in ^{90}Sr and ^{89}Sr units (SU). A significant, positive linear correlation for SU-90 and SU-89 in milk between the groups was obtained. During the experimental period, a herd of Holstein cattle without access to pasture, consuming a weighed amount of

feed, secreted 1.5% of their total ^{90}Sr intake into the milk. The reason for the consistently higher SU-89 and SU-90 in the milk of the bottom-grazing group may be that cows forced to graze more closely to the ground and possibly graze larger areas may consume more mat material than the top grazing cows. The mat, including the bases of stems, decaying organic matter, and surface roots contains most of the total Sr deposition. Another possible explanation for the difference is that the top grazers had the choice of more palatable portions of the plants, possibly containing less radiostrontium. (BBB)

22257 BIOLOGICAL EFFECTS OF IONIZING RADIATION ON MILK SYNTHESIS. III. EFFECTS ON MILK LIPASE, ESTERASE, ALKALINE PHOSPHATASE, AND LACTOPEROXIDASE ACTIVITIES. Luick, J. R. (Univ. of Alaska, College); Mazrimas, J. A. J. Dairy Sci., 49: 1500-4(Dec. 1966).

Studies were extended to higher dose levels with a ^{60}Co irradiator, and a new method was devised for circumventing uncertainties caused by diurnal fluctuations in enzyme activity encountered before. The udders of lactating dairy cows were exposed to 750 to 1800 R γ radiation. Milk lipase and esterase activities were depressed, lactoperoxidase activity unchanged, and alkaline phosphatase activity markedly enhanced. The threshold dose appeared to lie between 500 and 750 R. The discrepancy between dose levels required to produce enzyme inhibition in fresh milk and in milk produced by irradiated mammary tissue was noted and discussed. It is likely that the mechanisms of inhibition in these 2 instances are different. Responses observed in vivo are probably not the result of primary photochemical events. Possibly, metabolically active compounds produced and secreted by the damaged epithelium or parenchymal tissue, or changes in the vascular permeability of the alveolar cell membranes, are involved. If so, the nearly complete recovery of enzyme activity by 10 days' postirradiation implies that these lesions are soon repaired. (BBB)

22258 DNA METABOLISM IN PERFUSED ORGANS. II. INCORPORATION INTO DNA AND CATABOLISM OF THYMIDINE AT DIFFERENT LEVELS OF SUBSTRATE BY NORMAL AND X-IRRADIATED LIVER AND INTESTINE. Gerber, G. B.; Remy-Defraigne, J. (Centre d'Etude de l'Energie Nucleaire, Mol, Belg.). Arch. Int. Physiol. Biochim., 74: 785-806(1966).

Normal, regenerating, and regenerating x-irradiated liver of Wistar rats, as well as normal and x-irradiated intestine and and kidney, was perfused with different quantities of ^{14}C- and ^{3}H-thymidine. Formation of thymine, dihydrothymine, β-aminoisobutyric acid (BAIBA) and incorporation of the isotopes into DNA were determined. Only liver was capable of degrading thymidine to BAIBA and beyond. Catabolism of thymidine in the liver was extremely rapid and more than 100 times the quantity normally degraded could be handled by the liver. Regenerating liver degraded slightly less thymidine than normal liver, presumably because the DNA-synthesizing cells do not catabolize. Catabolism of thymidine and BAIBA appeared not to be altered in x-irradiated regenerating liver. Thus, it seems unlikely that increased catabolism of DNA in x-irradiated rats could result in a saturation of the enzymes degrading BAIBA, although retention of BAIBA by the liver may also lead to an increase in BAIBA available for excretion. A new technique for perfusing isolated intestine under physiological conditions is described. The perfused intestine degrades thymidine only to thymine and dihydrothymine, but incorporation into DNA is very active. (BBB)

22259 KINETICS OF CALCIUM METABOLISM IN THYROIDECTOMIZED RATS. Alonso, Guillermo L.; Mestorino, Robert J.; Houssay, Alberto B. (Univ., Buenos Aires). Endocrinology, 78: 240-4(Feb. 1966).

The effect of ^{131}I-induced ablation of the thyroid on ^{45}Ca metabolism was studied in Long-Evans rats. Radiothyroidectomy was performed with 100 μCi of ^{131}I, injected a month before the experiment. Ten-μCi doses of ^{45}Ca were injected intraperitoneally and measurements were performed in plasma and bone 4, 26, 50, 100, and 150 hr later. The results were calculated by the method of Ranney. Another experiment was conducted to determine the total excretion of ^{45}Ca during the first 24 hr after the injection. There was no significant difference in the plasma total Ca and the plasma ^{45}Ca specific activity and little difference in total excretion of ^{45}Ca between radiothyroidectomized and control rats. Bone ^{45}Ca specific activity was lower in thyroidectomized rats. The accretion rate and the amount of Ca reabsorbed from bone were lower in radiothyroidectomized rats. No significant change in the size of the exchangeable bone fraction was observed. These results were discussed and the hypothesis of the increase of the total pool of exchangeable Ca in thyroidectomized rats was formulated. (BBB)

22260 DIRECT INTRAVENOUS INJECTION OF CHROMIC-51 CHLORIDE COMPARED WITH ^{125}I-POLYVINYLPYRROLIDONE AND ^{131}I-ALBUMIN IN THE DETECTION OF GASTROINTESTINAL PROTEIN LOSS. Rootwelt, K. (Rikshospitalet, Oslo). Scand. J. Clin. Lab. Invest., 18: 405-16(1966).

The effectiveness of 3 radioisotope-labeled compounds for detecting loss of protein in the gut was compared. Also, the radiochemical stability of ^{131}I-labeled polyvinylpyrrolidone (PVP) was investigated for the first time. Radiation doses to the patients with each of the compounds were estimated. The ^{125}I-PVP preparation was injected intravenously together with ^{51}Cr chloride and ^{131}I-albumin in controls and patients with diseases affecting the gastrointestinal tract. The sp act. in urine, blood, and feces specimens was determined with a 5-in. scintillation crystal coupled to a 400-channel pulse height analyzer by analyzing the complex γ spectra obtained by means of a stripping technique. The behavior of ^{125}I-PVP was found to be identical to that described for ^{131}I-PVP, while injection of ^{51}Cr chloride with high sp act. led to results comparable to those reported after injection of ^{51}Cr-albumin. The whole-body dose after intravenous injection of ^{131}I-albumin is about 2 mrad/μCi. As the radioiodide uptake in the thyroid, salivary, and gastric glands is blocked by stable iodide, and the ^{131}I is not concentrated in other organs, yielding higher radiation doses in them. Five μCi ^{131}I-PVP injected intravenously probably would not deliver a total dose exceeding 100 mrad in any tissue or organ. Chromium-51 ion injected intravenously would deliver a radiation dose of 7 mrad/μCi. Direct intravenous injection of ^{51}Cr chloride is advocated as the best method. It is simple and the shelf life of the test compound dependent only on the physical half life of radio-chromium. Injections of 10 μCi ^{51}Cr chloride give sufficient activity in feces to avoid unreasonably long counting times in 5-day feces, while the whole-body radiation dose will not exceed 100 mrad. (BBB)

22261 OBSERVATIONS ON THE COURSE OF URINARY ^{42}K SPECIFIC ACTIVITY IN FASTING HUMAN SUBJECTS. O'Toole, James J.; Cech, Robert F.; Peterson, Richard E. (Veterans Administration Hospital, Iowa City, Iowa). Metab., Clin. Exp., 15: 1024-8(Nov. 1966).

The urinary elimination of radioactivity was followed for 6 days in 6 subjects given carrier-free ^{42}K. The obese subjects fasted this entire period, receiving only distilled water. A method is described for purifying high sp act. ^{42}KCl that contained significant amounts of other longer lived isotopes, apparently including ^{86}Rb, ^{134}Cs, and ^{137}Cs. A method is also described for isolating the small amounts of ^{42}K that appeared in urine. Equilibration of the isotope was not complete until after the third day. While the overall process of K equilibration may be delayed in fasting obese subjects, when compared to nonfasting normal subjects, the data presented indicated significant urinary sp act. decreases up to the fourth day following oral administration of ^{42}K, information which supports previous observations. (BBB)

22262 DEPENDENCE OF ^{131}I-LABELED THYROXINE BIOSYNTHESIS ON THYROIDAL ^{131}I UPTAKE AND ^{131}I-LABELED DIIODOTYROSINE FORMATION IN VIVO. Pitt-Rivers, Rosalind (National Inst. for Medical Research, London). J. Endocrinol., 36: 203-6(Oct. 1966).

The ^{131}I uptake and the distribution of ^{131}I in the iodoamino acids of the thyroid were measured in rats fed a low iodine diet and very small doses of antithyroid agents. At 16 hr and 4 hr after the dose the labeled monoiodotyrosine content was inversely proportional, and the labeled diiodotyrosine content directly proportional to the ^{131}I uptake. The ^{131}I-labeled thyroxine content was directly proportional to the ^{131}I uptake and labeled diiodotyrosine content. No obvious correlation between labeled triiodothyronine content and ^{131}I uptake or labeled iodotyrosine content was apparent. Evidently the biosynthesis of thyroxine depends only upon an adequate supply of diiodotyrosine. The situation with regard to triiodothyronine is more difficult to interpret. It seems that, given a minimum of mono- and diiodotyrosine in thyroglobulin, triiodothyronine will be formed in an amount which is constant within certain limits. Moreover, above this minimum, triiodothyronine formation appears to be independent of the level of either of its precursors. Its synthesis was only seriously impaired when the level of inorganic $^{131}I^-$ reaches significant proportions (30% or more of thyroidal ^{131}I), and reached a maximum when thyroxine synthesis had reached only about $\frac{1}{8}$ of its maximum value. (BBB)

22263 LOCALIZATION OF LIGHT-INDUCED BARIUM ACCUMULATION IN SPINACH CHLOROPLASTS. Nobel, P. S.; Murakami, S.; Takamiya, A. (Tokyo Univ.). pp 373-4 of Sixth Intern. Congr. Electron Microscopy, Kyoto, 1966. Tokyo, Maruzen Co., Ltd., 1966.

A light-induced uptake of various ions occurs in spinach chloroplasts in vitro. Calcium was accumulated in the light under conditions favoring the hydrolysis of ATP and uptake reached a max in about 30 min. Under these conditions, Sr was accumulated in a

light-induced process to an even greater extent than Ca. Electron microscopic evidence indicated that both Ca and Sr deposits are located on the lamellae. After a 15-min illumination with 1 m$\underline{M}$ $CaCl_2$, the average diameter of the deposits was 14.3 mμ, with 1 m$\underline{M}$ $SrCl_2$, the average dia of the deposits was 14.3 mμ, while with 1 m$\underline{M}$ $SrCl_2$ it was 20.7 mμ. The possible occurrence of electron-opaque particles in the presence of $BaCl_2$ was investigated under the same conditions. After 3 min in the light with 1 m$\underline{M}$ $BaCl_2$, numerous electron-opaque particles were evident on the lamellae of the chloroplasts. The average diameter was 10.6 mμ. Although the chloroplast limiting membrane was usually reptured, most of the chloroplasts remained as intact lamellar systems. When the illumination was increased to 30 min, the swelling was greatly enhanced and the chloroplasts were found mainly as small swollen lamellar fragments. More electron-opaque particles were observed, and the size distribution was broader. The average diameter of the deposits increased to 13.3 mμ. For chloroplasts incubated in the dark for 30 min with 1 m$\underline{M}$ $BaCl_2$, electron-opaque particles were nearly completely absent and the swelling also was much less. The mean diameter of the electron-opaque particles in the presence of Ba was less than that with Sr or Ca. (BBB)

22264 AUTORADIOGRAPHIC STUDY OF THE HISTOLOCALIZATION OF ^{85}Sr IN THE NEWBORN MOUSE. Tonna, E. A.; Pentel, L. (Brookhaven National Lab., Upton, N. Y.). Arch. Oral Biol., 12: 183-8(Feb. 1967). (BNL-9860).

Autoradiography was used to determine the histolocalization patterns and concentration of internal conversion and Auger electron-emitting ^{85}Sr in the newborn mouse. Pregnant Swiss albino mice were given $^{85}SrCl_2$ during the last trimester of gestation. Some fetuses were examined to determine the distribution of Sr relative to the fetal position within the uteri. Localization and quantization of radioisotope varied in litter mates, but did not coincide with the fetal position. Discrete localization was, however, consistently observed in the mineralizing matrices of bone and the dentin of developing incisors. Mouse litters from normal mothers nursed by ^{85}Sr treated mothers demonstrated detectable radiation in their bones and teeth, indicative of Sr transfer via lactation. Tissues of mice killed from 15 min to 4 hr after ^{85}Sr administration were processed routinely or cut in a cryostat and kept frozen to minimize isotope diffusion and autoradiograms were prepared. No autoradiographic grains were observed over cellular elements, thus eliminating the possibility of a cellular pathway for ^{85}Sr to mineralizing structures. (BBB)

22265 CONCERNING THE MECHANISM OF FORMATION OF UV-INDUCED THYMINE PHOTOPRODUCTS IN DNA. Wang, Shih Yi; Patrick, Michael H.; Varghese, A. J.; Rupert, Claud S. (Johns Hopkins Univ., Baltimore). Proc. Nat. Acad. Sci. U. S., 57: 465-72(Feb. 15, 1967).

The existence of intermediates in the formation of uv-induced thymine photoproducts of DNA was investigated. Two radioactive peaks (in addition to that of thymine) were revealed by paper chromatography in hydrolysates of DNA irradiated in vivo. These products are referred to as P_1 and P_2. The DNA irradiated in vitro gave 4 radioactive peaks. Two were chromatographically identical to P_1 and P_2. The two additional products, as yet unidentified, appear not only in irradiated, but also in unirradiated samples. Based on previous studies two possible intermediates, dithmyine peroxide (TOOT) and a thymine-coupled product (T-T) in the P_1 and P_2 formation might reasonably be postulated, each of which involves hydrogen removal from the 5-CH_3 group of thymine. In order to test for this removal, cells were doubly labeled with a mixture of thymines carrying tritium at the 5-CH_3 group and ^{14}C at the 2-carbon position of the ring. The occurrence of a reaction involving the loss of one H on the methyl group would result in a reduction in the $^3H/^{14}C$ ratio for one or both of the products. Direct photodimerization through 5,6-double bonds should not affect the methyl hydrogens, leaving the $^3H/^{14}C$ ratio unchanged in the products. An average reduction of 30% in the $^3H/^{14}C$ ratio for both P_1 and P_2 was found. The behavior of photoproducts from frozen solution of thymine and the effect of irradiation pH on P_1 and P_2 formation were studied. (D.H.M.)

22266 GLYCOLIC ACID LABELING DURING PHOTOSYNTHESIS WITH $^{14}CO_2$ AND TRITIATED WATER. Plamondon, J. E.; Bassham, J. A. (Univ. of California, Berkeley). Plant Physiol., 41: 1272-5(Oct. 1966). (UCRL-16919).

Earlier attempts to perform photosynthesis experiments in the presence of HTO and $^{14}CO_2$ gave uncertain and variable results. The principal problem was in obtaining accurate counting results for both tritium and ^{14}C. To obtain reliable counting results it was necessary to raise the ratio of tritium to ^{14}C in the incubation mixture to a high level. A 4.5% suspension of Chlorella pyrenoidosa was preilluminated for 1 hr in air, after which $^{14}CO_2$ and HTO were simultaneously introduced in a closed system. The HOT (1.0 C in 1 ml) was dropped in while $^{14}CO_2$ (50 μC/μmole) was added from a gas system. Chlorella were allowed to photosynthesize for short periods of time in the presence of $^{14}CO_2$ and HTO. Analysis of tritium and ^{14}C labeling of photosynthetic intermediate compounds showed that the $T/^{14}C$ ratio of glycolic acid was comparable to that of intermediate compounds of the photosynthetic carbon reduction cycle when photosynthesis was performed in nearly 100% oxygen and only slightly higher under steady-state conditions. It is concluded that formation of labeled glycolic acid as a consequence of its proposed hydrogen transport role in photosynthesis is quantitatively of limited importance compared to the net synthesis of glycolic acid from CO_2. (BBB)

22267 EFFECTS OF LEAD AND OTHER CATIONS ON PIAL ARTERIES OF THE MOUSE. Rosenblum, William I. (New York Univ., N. Y.). Acta Neuropathol., 5: 54-60(Oct. 4, 1965).

The action of Sr, Mg, and Ca on arteries of the pia was investigated in view of the fact that these ions are chemically related to Ba, shown to be a potent constrictor of pial arteries. Solutions of $MgSO_4$, $CaCl_2$, $SrCl_2$, $ZnSO_4$, and $Pb(NO_3)_2$ were tested for their effects on vascular dia and then the response to $BaCl_2$ was compared. None of these constricted pial arteries as did $BaCl_2$. Strontium and Mg in high concentration often brought about dilation, but these responses appeared nonspecific and the same proportion of dilations could be obtained with NaCl solutions of equal tonicity. Dilation occasionally occurred with the lower concentrations of Sr or Mg but these effects were also seen from time to time after application of isotonic saline. Calcium also dilated pial arteries, but the response to Ca differed from that to Mg, Sr, or hypertonic saline. In tests of the ability of the cations to inhibit the Ba contractile response, Ca, Zn, and Pb inhibited this response. The number of inhibitions elicited by Sr did not exceed the number that might be expected by chance alterations in the reactivity of the preparation. The effects of Ca were relatively slight, and generally resulted in only a small diminution in the size of the constriction. The effects of Zn and Pb were dramatic and definite, these ions producing a marked dilation of pial arteries which often exceeded in duration and magnitude that produced by other solutions or equal tonicity. These ions also caused profound inhibition of the contractile response to Ba. (BBB)

22268 ENZYME HISTOCHEMICAL STUDIES ON THE QUESTION OF THE GENESIS OF TISSUE LEUKOCYTES. Fischer, R.; Schaefer, H. E. (Univ., Bonn). Verhandl. Deut. Ges. Pathol., 49: 271-3(1965). (In German).

The presence of the following enzymes in leukocytes in various tissues and blood of the mouse and rat was determined: acid and alkaline phosphatases, several esterases, cytochrome oxidase, and peroxidase. Origin of the leukocytes was also studied in whole-body x-irradiated mice which received intravenous injections of rat bone marrow cells. The enzyme-histochemical pattern of the so-called tissue eosinophils in the stroma of the uterus of the rat and mouse is identical to that present in the blood and bone marrow eosinophils. In contrast, a clear difference was found between the enzyme content of the connective tissue cells or smooth muscle cells of the uterus and that of the tissue eosinophils. No so-called transitional forms could be observed, not even during the different phases of the cycle. A further proof of the hematogenous origin of the so-called tissue eosinophils was obtained from the experiments in which lethally x-irradiated mice received heterologous bone marrow grafts from the rat and estradiol injections. (BBB)

22269 HISTOLOGICAL AND BIOCHEMICAL CHANGES FOLLOWING X-IRRADIATION OF EXPOSED LIVER. Mehrotra, R. M. L.; Agarwal, S. K. (K. G. Medical Coll., Lucknow, India). J. Pathol. Bacteriol., 91: 207-13(Jan. 1966).

Exteriorized livers of rats were irradiated with 3000- or 25,000-R doses of 90-kv x radiation and examined histologically one to 20 days later. There were no differences in the recovery rates of the irradiated and control rats after the operation. One day after 3000-R irradiation, edema of the liver capsule, focal areas of necrosis in the subcapsular region, and mild periportal fatty infiltration were seen. At 5, 10, and 20 days, the livers showed slight fibrous thickening of the capsule on the irradiated surface, with no change in the parenchyma. One day after 25,000-R irradiation, 2 out of 6 animals showed subcapsular focal areas of necrosis, and periportal fatty change in 4. In rats receiving 300 R there was an increase in wet liver weight and hepatic glycogen as compared with controls. Rats receiving 25,000 R showed an increase in wet liver weight at 5, 10, and 20 days, in hepatic glycogen at 5 days, in water content at 1 and 5 days, and a decrease in liver nitrogen at 10 and 20 days. The biochemical findings did not appear to follow any regular pattern, but seemed to be related to histopathological alterations in the liver, for they are significant at intervals when morphological changes are well pronounced. The decrease in liver nitrogen manifested itself as impaired protein synthesis. (BBB)

22270 KINETICS OF CALCIUM METABOLISM. Alonso, G. L.; Nikonov, J. M.; Mestorino, R. J.; Calvi, R. (Univ., Buenos Aires). Acta Physiol. Latinoamer., 15: 333-42(1965).

A new method is proposed for calculation of the bone accretion rate (A), exchangeable bone fraction size (E), and radiocalcium reabsorbed from bone (Ca_{rbf}), to avoid the inaccuracy introduced when general methods are used to solve the equation proposed by Bauer, Carlsson, and Lindquist. In experiments on rats using ^{45}Ca as tracer, the results agreed with the Bauer, Carlsson, and Lindquist assumptions on the existence of small amounts of ^{45}Ca reabsorbed from bone a short time after injection, but disagreed with their finding of a similarity of specific activities between plasma and exchangeable bone in the same period. From this unlikely result, bone accretion rate was calculated to be >300%, the exchangeable bone fraction >1400%, and total amounts of ^{45}Ca reabsorbed from bone <1% compared with the calculated values for the original method. (BBB)

22271 THE EFFECT OF THE LASER ON DOG BLADDERS: A PRELIMINARY REPORT. Parsons, Robert L.; Campbell, James L.; Thomley, Miles W.; Butt, Cecil G.; Gordon, Thomas E. Jr. J. Urol., 95: 716-17(May 1966).

Possible use of laser radiation for treating bladder tumors was explored by an examination of the effect of 6943-Å energy on canine bladder. The bladders of adult greyhound dogs were exposed through suprapubic incisions to 5 different energy levels: 10, 20, 30, 40, and 50 J and, the dogs were sacrificed at 10 to 14 days. On 1 dog, black India ink was applied to areas of the bladder to increase the absorption of the 50-J laser shot. At the time of impact, definite and discrete areas of tissue destruction were noted along the bladder mucosa in energy levels ranging from 20 to 50 J. In no instance was there evidence of serosal damage or of perforation. On histologic examination, the direct effect of laser radiation appeared confined to the bladder mucosa where there was evidence of cell destruction and regeneration at 10 days. Cells were hyperchromatic, irregular, and arranged in thin layers. A sharp line of demarcation between the affected area and the surrounding tissue was noted. It was concluded that a laser beam could be used under simulated cystoscopic conditions. There was no adverse effect on the dog bladder except for the minimal areas of coagulation necrosis at the point of impact. (BBB)

22272 CALIBRATION OF STRIPPING FILM AUTORADIOGRAPHY IN SECTIONS OF RAT LIVER LABELLED WITH TRITIUM. Oja, H. K.; Oja, S. S.; Hasan, J. (Univ. of Helsinki. Inst. of Occupational Health, Helsinki). Exp. Cell Res., 45: 1-10 (Jan. 1967).

Four different doses of ^{3}H-L-tyrosine were injected into the peritoneal cavity of 1-week-old rats, which were killed after 2 hr. Central parts of their livers were removed, fixed, embedded in paraffin, cut into sections of 1 to 10 μ thickness, and mounted on glass slides. The sections were coated with stripping film from Ilford nuclear research plates K-5, and exposed in dry air at 4°C for periods varying from 1 to 17 days. After processing a 15°C in complete darkness, the fixed films were rinsed, the underlying sections stained with hematoxylin-eosin, and mounted in balsam. The developed grains were counted over known areas of the sections, as well as over inactive sections mounted on the same slides, and the total areas of the sections were measured. From these data and from the time of exposure the net number of developable grains appearing in the emulsion per unit exposure time was computed. The glass slides carrying the sections were then crushed into appropriate reaction ampoules, the tritium in them was converted into gas, and its absolute activity was determined in metal cathode internal counters. The ratio of the total number of developable grains over a section to the total number of distintegrations in that section, multiplied by 100, was taken as the autoradiographic efficiency expressed in percent. The relative grain yield was found to decrease with time; the nonlinearity in this relationship was evident, despite the random variation in the results, from the 11th day onward. Actually, the efficiency of grain production seemed to decrease, rather linearly and largely independently of both section thickness and amount of radioactivity in it, as the time of exposure increased from 1 to 17 days. Possible reasons for this are discussed with reference to earlier results, and coincidence saturation is excluded, while latent image regression and change backscattering remain as potential explanations. The efficiency of grain production after 7 days of exposure declined in a nonlinear fashion from about 14 percent in sections of 1 μ thickness to about 2.5 percent in 10 μ sections. The grain yields in sections of 5 and 10 μ thickness were approximately equal. The results are compared to those of previous authors, and backscattering, not considered by them, is taken into account in a rough calculation of the sensitivity of the stripping film on the basis of available data. The effect of an electrical charge on a surface on its backscattering properties, in addition to the atomic number of the material, is suggested as one possible explanation for the difference between the sensitivity obtained for the stripping film (70 percent) and that given for the equivalent emulsion (100 percent). (auth)

22273 COMPARATIVE EFFECTIVENESS OF INTRAPERITONEAL AND INTRAMUSCULAR ^{3}H-TDR INJECTION ROUTES IN MICE. Skougaard, M. R.; Stewart, P. A. (Brookhaven National Lab., Upton, N. Y.). Contract AT(30-2)-Gen-16. Exp. Cell Res., 45: 158-66(Jan. 1967). (BNL-9219).

Blood samples were taken from 96 mice at various time intervals after intraperitoneal (IP) or intramuscular (IM) injections of tritiated thymidine (^{3}H-TDR). The total volatile and nonvolatile ^{3}H-plasma activities were determined in a liquid scintillation spectrometer. The ^{3}H-TDR time curve was found by paper chromatography analysis of the nonvolatile plasma components. Following IP injections, the plasma ^{3}H-TDR concentration decreased exponentially with a half-time of 2.9 min, and with effectively complete plasma clearance, by 30 min. With IM injection, the maximum ^{3}H-TDR concentration occurred after 5 min, followed by a slower exponential decrease than that after the IP injection. Following either route of administration, the cumulative ^{3}H-TDR amount was approximately the same. Autoradiographic grain counts were carried out on squash preparations from tongue and crypt epithelium. The yield of grain counts was about the same in the tongue epithelium following IP and IM injection and in crypt cells following IM injection. In the crypt cells after IP injection, however, the mean grain count was about twice that in the other 3 groups. It is suggested that this difference might be due to the uptake of ^{3}H-TDR from the peritoneal cavity into the intestinal circulation resulting in a higher effective dose for the gut compared to the tongue epithelium. (auth)

22274 A METHOD FOR THE AUTORADIOGRAPHIC DETERMINATION OF ABSOLUTE SPECIFIC RADIOACTIVITY IN CELLS. Ritzen, M. (Karolinska Institutet, Stockholm). Exp. Cell Res., 45: 250-2(Jan. 1967).

Sections of commercially available plastic, tritiated poly-(methyl-T)methacrylate or tritiated poly(n-butyl-T)methacrylate, fixed to a microscope slide were used as a reference of absolute specific radioactivity in autoradiograms of tissues. The plastic reference sections, with emulsion, were treated and stored in exactly the same manner as the cellular specimens. The reference system proved to be of great value in studying the incorporation of ^{3}H-5-hydroxytryptamine and ^{3}H-5-hydroxytryptophon into rat peritoneal mast cells. Variations in film thickness did not influence ^{3}H autoradiography. When poly(methyl-^{14}C) methacrylate was used as a reference for ^{14}C autoradiography, the thickness of the plastic sections had to be determined very accurately for good results. (C.H.)

22275 EXPERIMENTAL THROMBOSIS: STATIC COAGULATION STUDIES USING THE SERUM OF NORMAL RABBITS AND RABBITS WITH 1700 r WHOLE BODY IRRADIATION. Fiam, Bela; Gazso, Margit. Honvedorvos, 18: 127-31(Apr.-June 1966). (In Hungarian).

By using isolated mesenterial segments of rabbits, the following was demonstrated: (1) Normal contact rabbit serum does not possess any thrombus-inducing, so-called "AP" effect. (2) Contact rabbit serum can be activated with kaolin and the AP formed is capable of static thrombus formation within the recipient animal. (3) In animals subjected to whole-body irradiation with 1700 R, the serum retains its kaolin activation and thrombus forming ability 96 hours after irradiation. This points to the fact that the contact system plays no role in the development of early coagulation disturbance. (JPRS)

22276 PREDICTING THE TOTAL PROJECTED INTAKE OF RADIOIODINE FROM MILK BY MAN: MODIFICATION OF THE ORIGINAL EQUATION. Lengemann, F. W. (Cornell Univ., Ithaca, N. Y.). Health Phys., 13: 521-2(May 1967).

A recently developed (Lengemann, Health Phys., 12: 825; 831, (1966)) simplified method of prediction of radioiodine intake from milk by man, from a single deposition during the time cattle were on pasture, is discussed. In the expression employed for the calculation the factor to account for loss of radioiodine from grass due to physical and chemical actions was applied to the time from initial deposition until secretion of a particular sample of milk. This is not quite precise, since the effect of pasture loss is operative only up to the time of pasture consumption. Pasture loss has no effect during the period from consumption by the cow to the time of milk secretion. In studies regarding radiocaesium contamination of pastures a slighly different equation was developed, allowing for this correction. It is shown that so far as radioiodine is concerned the correction is of little significance, but this is not true for ^{137}Cs or ^{90}Sr, since both of these radionuclides have long half-lives and long residence times in cattle. For ^{137}Cs the error can be as great as 30%. (UKAE)

22277 ABSORPTION AND TRANSLOCATION OF FOLIAR-APPLIED IRON. Eddings, J. L.; Brown, A. L. (Univ. of California, Davis). Plant Physiol., 42: 15-19(Jan. 1967).

The absorption of $^{59}Fe^{3+}$ by the leaves of various plant species was studied. Stomata were found to play a major role in foliar absorption when leaves were totally submerged in treatment solutions, and a correlation was found to exist between stomatal area and absorption. Day treated leaves absorbed much more than did night treated leaves. The use of a surfactant markedly increased absorption. Translocation from treated leaves was demonstrated and was found to vary with species. (auth)

22278 IMMUNOLOGICAL CHARACTERISTICS OF SILVER-LABELED PROTEINS. Kolchakov, K.; Kantardjiev, V. (Higher Medical Inst., Sofia). Compt. Rend. Acad. Bulg. Sci., 18: 363-4(1965).

Three percent human serum albumin was prepared and a portion was labeled with radiosilver. Parallel hyperemisation was carried out with both antigens on two groups of 5 rabbits each. Rabbit antiserum was used to titrate the antigens. On a double two-way diffusion in a petri dish with agar, both albumins gave the same precipitation titre towards the antigen. It was established that the precipitation titre of the serum was not changed by the amount of silver added to the antigen up to the concentration of 20 atoms Ag/molecule albumin. Under the experimental conditions assigned, the sulfhydryl groups of the albumin molecule were bound to a silver atom. The established absence of change in antigen specificity after labeling of the albumin with silver indicated that the sulfhydryl groups did not participate as a determinant group on the antigen. (B.H.S.)

22279 EFFECT OF ^{60}Co γ-IRRADIATION ON FAT MOBILIZATION AND GROWTH IN GERMINATING PEANUT. Mathur, J. M. S. (Indian Agricultural Research Inst., New Delhi). Indian J. Biochem., 3: 254-5(1966).

Germinating peanut seeds were exposed to γ radiation from a ^{60}Co source. It was found that the most effective dose for growth stimulation was 500 R. No change was observed in acetyl values of fat from the seedlings of irradiated seeds at any stage of growth; this suggested that in vivo hydrolysis of triglycerides in peanut seedlings was not affected by γ radiation of the seed. Iodine values of fat and the content of non-saponifiable lipids were determined. An increase in iodine values and a simultaneous decrease in biosynthesis of non-saponifiable lipids of seedlings suggested that lipases in the seedlings acquired specificity after treatment with γ radiation which resulted in selective mobilization of certain fatty acids. (auth)

22280 INHIBITION OF CHLOROPHYLL A AND B SYNTHESIS IN CHLAMYDOMONAS REINHARDI MUTANT STRAIN y-2 BY IONIZING RADIATION. Kohn, H. I. (Harvard Univ., Boston); McLeod, G. C.; Wright, K. A. Radiat. Bot., 7: 123-8(Apr. 1967).

The inactivation of a chlorophyll-synthesizing system by 3 MeV electrons (and also 250 KV x rays) was studied in the y-2 mutant strain of Chlamydomonas reinhardi. The organism was depleted of chlorophyll by cultivation in the dark on acetate medium for 96 hr, then irradiated, and then illuminated to induce and maintain chlorophyll synthesis. Cell division was completely inhibited at a radiation dose of 50 to 75,000 rad. The quantity of chlorophyll A synthesized (as a percentage of the control) was a simple negative log function of radiation dose, with an average D_{37} of 110,000 rad. On the basis of simple target theory, the predicted size of the inactivated synthetic unit would be equivalent to a molecular weight of 1 to 10 million. The chlorophyll B system was more resistant ($D_{37} \sim 150,000$) and its nonlinear survival curve did not parallel that of chlorophyll A. This difference between chlorophylls A and B is consistent with the possibility that chlorophyll B synthesis proceeds independently of chlorophyll A synthesis in the regreening cell. (auth)

22281 EFFECT OF ULTRAVIOLET RADIATION ON THE CATALYTIC ACTIVITY OF PROTEINASE. Ivanov, I. D.; Rakhleeva, E. E. (Inst. of Microbiology, Moscow). Ukr. Biokhim. Zh., 38: 625-9(1966). (In Russian).

Studies were undertaken to point out the connection between the active center with ternary structure of proteinase in the presence of a substrate (gelatine), an inhibitor (diisopropylfluorophosphate (DPP)) and deoxyribonucleic acid (DNA) during irradiation with ultraviolet rays. In the presence of a substrate before irradiation an increase is observed in the height of the subtilisine wave, and during irradiation the destruction of the globular part occurs more rapidly and profoundly. On irradiation is samples containing substrate, the catalytic activity is reduced to a lesser extent, i.e., stabilization of the active center occurs. In the presence of DPP there is a decrease in the height of the subtilisine wave, which is explained by the disturbance of formation of intracomplex compounds of cobalt ions with subtilisine. DNA increases the height of the subtilisine wave and acts non-specifically on the catalytically active center of the enzyme. (auth)

22282 A NEW TECHNIC FOR THE PRODUCTION OF AN IN VIVO LABELED FIBRINOGEN. Gans, Henry; McLeod, James; Lowman, James T. (Univ. of Minnesota, Minneapolis). Contract AT(11-1)-1274. Blood, 29: 517-25(Apr. 1967). (COO-1274-2).

The fact that in vitro labeled proteins, as a rule, exhibit faster turnover rates than in vivo labeled materials led us to explore means of obtaining in vivo labeled fibrinogen of high specific activity. It was found that defibrination of the rat provides a stimulus for the liver to regenerate fibrinogen at an accelerated rate. Administration of seleno^{75} methionine shortly after thrombin-induced defibrination of the animal resulted in the incorporation of large quantities of the label. The rate of incorporation was further increased if the amino acid was administered as a slow infusion during the entire period of fibrinogen regeneration. In addition, prior nephrectomy of the animal would appear to result in a slight increase in specific activity of the fibrinogen preparation obtained. The results of these studies indicate that defibrination, nephrectomy, and the prolonged infusion of the labeled amino acid selenomethionine provided us with a technique for obtaining a biosynthetically labeled, γ-emitting, fibrinogen preparation of high specific activity. (auth)

22283 UPTAKE OF FIBRIN AND FIBRIN-DEGRADATION PRODUCTS BY THE ISOLATED PERFUSED RAT LIVER. Gans, Henry; Lowman, James T. (Univ. of Minnesota, Minneapolis). Contract AT(11-1)-1274. Blood, 29: 526-39(Apr. 1967). (COO-1274-1).

The uptake of ^{75}Se-labeled rat fibrin and a specific preparation of fibrin degradation products by an isolated, perfused liver was studied. The rapid phase T ½ for fibrin in the perfusate was approximately 9 minutes. This is comparable to that found for aggregated ^{131}I B.S.A. and colloidal gold in the same system. The loss of activity from the blood closely paralleled the increased activity recorded in the liver. No radioactivity was found in the bile samples or the T.C.A.-soluble fraction of plasma. Microradioautographs of washed liver tissue following the labeled, fibrin perfusion suggest the presence of the label on or in the Kupffer cells. Labeled rat fibrin preparations, digested by the action of "cold" rat plasmin to a distinct endpoint, were found to contain 3 distinct fractions on paper electrophoresis. Addition of these fractions to the perfusate resulted in approximately 25% clearance of radioactivity over a 3-hour period. Hence, clearance of this specific F.D.P. preparation occurs at a much slower rate than that of fibrin. The T ½ was found to be in excess of 12 hours. These findings appear to confirm Lee's observation that cells of the reticuloendothelial system are involved in the elimination of free circulating fibrin and its metabolic products. (auth)

22284 DISTURBANCE OF THE MITOTIC ACTIVITY OF BONE MARROW HEMOCYTOBLASTS IN ACUTE RADIATION SICKNESS AND THE ACTION OF CHEMICAL MUTAGENIC AGENTS. Goldberg, E. D.; Goldberg, D. I.; Golubev, I. V. Arkh. Patol., 29: No. 2, 25-30(1967). (In Russian).

A direct relation between the radiation dose and the intensity of formation of gigantic hemohistoblasts in the bone marrow of experimental animals was revealed. Preliminary administration of turpentine intensified the phenomenon of gigantic cell formation. Following administration of a number of anticancer and antileukemic preparations there are also formed gigantic hemocytoblasts at the early periods of hemopoiesis; this phenomenon is intensified when turpentine is preliminarily administered. Formation of gigantic cells is associated with a change of reticular elements to endomitotic cycle. The greater part of the hemohistoblasts retained their capacity to differentiation in the direction of gigantic forms of myeloid series; anomalic mitoses are revealed in the lesser part. Amitotic division of nucleus without cytokinesis may lead to the formation of gigantic multinuclear cells. (auth)

22285 CHANGES IN THE GLYCOGEN CONTENT IN THE LIVER OF IRRADIATED MICE IN BONE MARROW TRANSPLANTATION. Ogandzhanyan, E. E.; Saakyan, D. G. Arkh. Patol., 29: No. 2, 44-7(1967). (In Russian).

This investigation was aimed at ascertaining the character of glycogen metabolism in the liver of irradiated black mice of the C57/6 strain and studying the effect of intrasplenic bone marrow transplantation on carbohydrate metabolism in the hepatic cells. Irradiation of the animals with lethal x ray doses (600 R) caused observed changes in glycogen metabolism in the liver. The first day—there were no shifts in the distribution of glycogen or in its quantity. A rise in glycogen content, on the 4th day, was replaced by considerable reduction of carbohydrate content on the 10th day of radiation sickness. Low polysaccharide content is character-

istic of hepatic cells during the subsequent periods of investigation. With bone marrow transplantation accompanied by prophylactic administration of synestrol a drop in the glycogen content is less and carbohydrate metabolism normalizes earlier. (auth)

22286 FATE OF SODIUM PERTECHNETATE-^{99m}Tc. Razzak, Muhammad Abdel (Cairo Univ.); Naguib, Mahmoud; El-Garhy, Mohamed. J. Nucl. Med., 8: 50-9(Jan. 1967).

The tissue distribution of sodium pertechnetate-^{99m}Tc was studied in white mice. The highest levels of radioactivity were found in the stomach and kidneys, followed by the liver and lungs, and then the other organs. Furthermore, radioactivity per gram tissue of all the organs examined with the exception of the kidneys decreased markedly with time. The effective half-time for this disappearance of activity was shortest in the heart, lungs, testes, and salivary glands, medium with the liver and spleen, and slowest for the stomach. After pretreatment with potassium perchlorate, the disappearance of labeled pertechnetate from the circulation of dogs became slower and the tissue concentration of radioactivity in white mice was much lowered. As regards the distribution of ^{99m}Tc obtained from ^{99}Mo prepared by neutron bombardment, it proved to be similar to that described above, except for the much lower level of radioactivity in the kidneys and the slower disappearance of activity from the organs. Reasons are suggested for the explanation of these findings. (auth)

22287 CIRCADIAN PHASE RELATIONSHIPS OF THYMIDINE-^{3}H UPTAKE, LABELED NUCLEI, GRAIN COUNTS, AND CELL DIVISION RATE IN RAT CORNEAL EPITHELIUM. Scheving, Lawrence Einar; Pauly, John Edward (Chicago Medical School. Tulane Univ., New Orleans). J. Cell Biol., 32: 677-83(Mar. 1967).

Significant differences in the uptake of thymidine-^{3}H, percentage of labeled cells, number of grains per labeled nucleus, and mitotic rate were noted in rat corneal epithelium along a 24-hr time scale. These were demonstrated by injecting subgroups of 5 animals every hr during a 24-hr period with thymidine-^{3}H, sacrificing them 2 hr later, and analyzing the corneal epithelium by scintillation counter and radioautographic techniques. The increase in uptake during specific periods of the 24-hr time scale is attributed to an acceleration in the rate of DNA synthesis by individual cells and to an increase in the percentage of cells in the population actively synthesizing DNA. (auth)

22288 THE USE OF FORMALDEHYDE-TREATED ^{131}I-ALBUMIN IN THE STUDY OF DIGESTIVE VACUOLES AND SOME PROPERTIES OF THESE PARTICLES FROM MOUSE LIVER. Mego, John L.; Bertini, Francisco; McQueen, J. Donald (Baltimore City Hospitals. Johns Hopkins Univ., Baltimore). J. Cell Biol., 32: 699-707(Mar. 1967).

The trichloroacetic acid–soluble radioactivity released during incubation of mouse liver particles containing intravenously injected formaldehyde-treated ^{131}I-albumin consisted almost entirely of ^{131}I-iodotyrosine. The material was shown to be excreted into the medium and was not due to disruption of the particles by acid. Triton X-100 or the absence of sucrose in the medium inhibited hydrolysis of the particle-associated labeled protein. This inhibition was due to disruption of the digestive vacuoles and dilution of the protein and cathepsins in the suspending medium. These results and other experimental evidence strongly suggest that the ^{131}I-albumin–containing liver particles are digestive vacuoles. The results also establish that ^{131}I-albumin may be used to study these vacuoles. High concentrations of sucrose (1M) inhibited degradation of intraparticulate protein. However, 1M salts inhibited only the rate of the digestion. Sucrose had an inhibitory effect on a crude cathepsin preparation, and salts stimulated the activity when ^{131}I-albumin was used as substrate. The effect of high sucrose concentrations as an inhibitor of protein hydrolysis within digestive vacuoles was, therefore, most likely due principally to an inhibition of cathepsin activity within the vacuoles. The effect of salt was probably caused by a stimulation of both intra- and extra-particulate cathepsin activities, although 0.5 to 1.0M KCl appeared to protect the particles. (auth)

22289 STUDIES ON PROTEIN UPTAKE BY ISOLATED TUMOR CELLS. III. APPARENT STIMULATIONS DUE TO pH, HYPERTONICITY, POLYCATIONS, OR DEHYDRATION AND THEIR RELATION TO THE ENHANCED PENETRATION OF INFECTIOUS NUCLEIC ACIDS. Ryser, Hugues J.-P. (Harvard Univ., Boston). J. Cell Biol., 32: 737-50(Mar. 1967).

Fixation of ^{131}I-serum albumin by Ehrlich ascites tumor cells in suspensions and sarcoma S-180 monolayers was measured under experimental conditions. Anaerobic incubation and inhibitors of the oxidative metabolism critically restricted the range of glucose concentrations capable of supporting cell life; in glucose concentrations higher than 10^{-2}M, Ehrlich cells suffered from their own acid production; in concentrations 10^{-2}M, lower than they underwent damage by starvation. Both types of damage were accompanied by increased albumin fixation unrelated to pinocytosis. Different procedures recommended to enhance the uptake of infectious viral RNA by animal cells in culture were tested for their ability to increase albumin uptake. They enhanced the penetration of both albumin and vital dyes and decreased the viability of cell populations. Their effect, therefore, is related to cell damage. It was postulated that reversible damage to cells favors RNA infection by leading to abnormal uptake processes and by decreasing intracellular digestion. This abnormal uptake is different from pinocytosis and also from the massive fixation of albumin to dead cells. The latter phenomenon is due to adsorption by intracellular sites exposed by disruption of the cell membrane. Polycations are able to induce all three forms of fixation depending on the experimental conditions. (auth)

22290 LOSS OF LIPID DURING FIXATION FOR ELECTRON MICROSCOPY. Morgan, Thomas E.; Huber, Gary L. (Univ. of Washington, Seattle). J. Cell Biol., 32: 757-60(Mar. 1967).

Tritiated choline was injected intraperitoneally into newborn guinea pigs and the rate of its incorporation into lung phospholipid was determined. Samples of lung containing labeled phospholipid were prepared for electron microscopy by fixation with one of 4 fixative schemes, followed by alcohol-propylene oxide dehydration and Epon 812 embedding. Losses of radioactivity were 66.9% of total radioactivity when fixed in s-collidine-buffered osmium tetroxide, 46.5% when fixed in 4% buffered formalin followed by osmium tetroxide, 39.0% when fixed in 2% glutaraldehyde followed by osmium tetroxide and 51.3% when tricomplex fixation was employed. Although some of the radioactivity lost was water soluble, 9.9 to 37.8% of lipid-soluble radioactivity was lost during preparation for electron microscopy. (auth)

22291 A STUDY OF THE MOBILIZATION OF RADIOMERCURY FROM THE KIDNEY, INDUCED BY ADMINISTRATION OF POLYAMINO–POLYCARBOXYL AND DITHIOL MOLECULES IN THE RAT. Martinenghi, C.; Riccardi, A. (Univ., Milan). Med. Nucl. Radiobiol. Lat., 9: 21-49(1966). (In Italian).

A comparison was made between EDTA, DTPA, and BAL for their properties favoring excretion of mercury-203 from the kidney following administration in a tracer amount as Chlormerodrin. Sprague–Dawley rats were used. A NaI(Tl) scintillation detector was used for external counting. Chelating efficacies were correlated with toxicities in each case, the toxicity being expressed as $LD_{50/30}$. Each drug was administered at three levels; $\frac{1}{3}$, $\frac{1}{9}$, and $\frac{1}{27}$ of $LD_{50/30}$. Hypotheses are advanced on biological action of the diuretics. (TSS)

22292 ON THE PROBLEM OF DISTURBANCES OF THE PYRIDINE NUCLEOTIDES IN IRRADIATED ORGANISMS. Zicha, B.; Benes, J. Vet. Med. (Prague), 12: 107-18(Feb. 1967). (In Czech).

The effects of in vitro x-irradiation on the fluorescence and ultraviolet absorption properties of nicotinamide adenine dinucleotide (NAD) and reduced nicotinamide adenine dinucleotide ($NADH_2$) at a dose of 42,000 R was determined. The fluorescence of $NADH_2$ was decreased and the uv absorption maximum was decreased to 340 nm. Absorption at 260 nm (nanometer) corresponding to that of purine bases of adenine was not significantly disturbed and oxidated NAD, as determined by fluorescent spectroscopy, did not appear. Fluorescence-maximum for NAD decreased under anaerobic conditions and in the presence of proton donors; reduction, however was not ascertained. Fluorescence-spectra of NAD under aerobic conditions and in the absence of proton donors were identical to those of nonirradiated NAD. The uv spectra revealed no significant changes in absorption. The total amount of pyridine nucleotides in the liver of whole-body x-irradiated rats (1400 R) was decreased. The liver was able, however, to retain normal reduction degree within the range of 15% at 3 hr postirradiation when the greatest change was observed. The total level of pyridine nucleotides in mitochondria isolated from the liver of the x-irradiated rats decreased. It was concluded that the mitochondria retained their ability to transfer H-protons and that the disturbance in oxidative phosphorylation probably followed the stages of H-transfer from donor to NAD. (B.H.S.)

22293 THE EFFECT OF X-RAY IRRADIATION ON RNA BIOSYNTHESIS IN RAT LIVER AND IN MOUSE EHRLICH ASCITES CARCINOMA. Mant'eva, V. L.; Rapoport, E. A.; Tul'kes, S. G.; Zbarskii, I. B. (Severtzov Inst. of Animal Morphology, Moscow. Inst. of Medical Radiology, Obninsk, USSR. Inst. of Molecular Biology, Moscow). Vop. Med. Khim., 12: 407-12(July-Aug. 1966). (In Russian).

An investigation was made of the effect of x-ray irradiation upon biosynthesis of D-RNA and R-RNA in the chromosome-nucleoulus apparatus and r-RNA and s-RNA in cytoplasm of rat liver cells and mouse Ehrlich ascites carcinoma cells. It has been shown that 2 hours after total irradiation of the animals

activation is observed of the biosynthesis of nuclear R-RNA and D-RNA and also of r-RNA and s-RNA in rat liver cytoplasm. In the case of mouse Ehrlich ascites carcinoma on the contrary inhibition is observed of the same RNA fractions. The x-ray irradiation does not affect the composition of total and new formed r-RNA and D-RNA in chromosome-nucleolus apparatus of rat liver cells and mouse Ehrlich ascites carcinoma cells. (auth)

22294 EXPERIMENTS RELATED TO THE CORRELATION BETWEEN THE BIOLOGICAL EFFECTS OF IONIZING RADIATION AND OF MAGNETISM. I. THE EFFECT OF IONIZING RADIATION ON THE DIAMAGNETISM OF ERYTHROCYTES. Santha, Andras. Orv. Hetilap, 18: 143-9(Apr.-June 1966). (In Hungarian).

By using a homemade magnetron, it was successfully demonstrated that the diamagnetism of erythrocytes, subjected either in vivo or in vitro to the effect of ionizing radiation, decreased. In spite of the inadequacies of the registration method used so-far, an existing relationship between the phenomenon observed and the radiation dose used could be determined. Further studies, in progress since the introduction of the photogrammetric registration technique, hold promise for the exact determination of the dosage dependency and, on this basis, for the subsequent estimation of the radiation dose received. (JPRS)

22295 STUDY OF THE RADIATION DAMAGE TO ERYTHROPOIESIS USING AN IRON ISOTOPE IN MICE. I. ^{59}Fe INCORPORATION INTO THE ERYTHROCYTES AND STORAGE ORGANS OF NORMAL AND IRRADIATED MICE. Sztanyik, Laszlo; Mandi, Erika. Honvedorvos, 18: 117-26(Apr.-June 1966). (In Hungarian).

In normal mice, a considerable portion of the iv-administered, radioactive ^{59}Fe isotope is incorporated into the erythrocytes and appears in the circulation in about 72 hours. The rest of the radioactive iron is taken up mainly by the storage organs—bone marrow, liver, and spleen. When the iron isotope is administered 24 hours after irradiation, the extent of erythrocyte labeling is decreased in inverse proportion to the dose used for irradiation although the rate of labeling remains virtually unchanged. According to this, the 72 hour iron uptake is a reliable reflection of the actual state of erythropoiesis both in normal and irradiated mice. The change in the relative specific activity of storage organs is a less suitable index for this purpose. (JPRS)

22296 DATA ON THE RADIOMIMETIC EFFECT OF MUSTARD GAS. II. CHANGES IN ADRENAL FUNCTION IN CASES OF EXPERIMENTAL RADIATION SICKNESS AND IN NITROGEN MUSTARD POISONING: CHANGES IN RESPONSE TO AET ADMINISTRATION. David, Gabor. Honvedorvos, 18: 132-6(Apr.-June 1966). (In Hungarian).

The changes in adrenal function were studied in rats treated first with AET, followed by poisoning with nitrogen mustard. It was concluded that AET is not merely a radiation-protective compound but it is also effective in cases of poisoning by radiomimetic compounds. Furthermore, treatment with AET previous to poisoning has a favorable influence on the ability of the adrenals to release and synthesize their hormones. (JPRS)

22297 RADIORESISTANCE OF THE ENGULFING AND DEGRADATIVE CAPACITIES OF PERITONEAL PHAGOCYTES TO KILOROENTGEN X-RAY DOSES. Perkins, Eugene H.; Nettesheim, P.; Morita, T. (Oak Ridge National Lab., Tenn.). Res. J. Reticuloendothel. Soc., 3: 71-82(1966). (ORNL-P-1958).

Although the reticuloendothelial system (RES) appears to be radioresistant as examined histologically, the degree of resistance of its function to radiation is not clear. To clarify this problem in vitro studies were conducted on the effect of x rays on phagocytic cells obtained from the peritoneal cavity of mice. The relative phagocytic efficiency of the cultures was assessed 1 hr after the addition of sheep red blood cells. The phagocytes were irradiated and then cultured for 0, 6, 12, or 24 hr before their phagocytic capacity was measured. Immediately after exposure to 20,000 R x radiation the cells phagocytized opsonized sheep cells as well as their unirradiated counterparts. The engulfing and degradative capacities of peritoneal phagocytes were found to be resistant to supralethal levels of radiation. The engulfing capacity of cultures of irradiated phagocytes decreased with time due to death of cells rather than loss of function. Supralethal levels of irradiation failed to alter the intracellular degradative capacity of surviving cells. The D_{37} value of these cells is many times larger than the D_{37} value of 70 to 80 R established for cells involved in antibody response. Therefore, if phagocytic cells play a role in the initiation of antibody response, the radiosensitive event must be post-phagocytic. (BBB)

22298 EFFECTS OF ETHYLENEDIAMINETETRAACETATE AND METAL IONS IN INTESTINAL ABSORPTION OF VITAMIN B_{12} IN MAN AND RATS. Okuda, Kunio; Sasyama, Katsumi (Kurume Univ., Japan). Proc. Soc. Exp. Biol. Med., 120: 17-20 (Oct. 1965).

The influence of Sr, Ca, Mg, Zn, Fe(II), and Fe(III) ions on the effect of ethylenediaminetetraacetate (EDTA) on absorption of vitamin B_{12} was examined. Administration of 2 g of EDTA to humans immediately after ^{60}Co-vitamin B_{12} abolished absorption of a physiological dose of 0.2 μg, whereas 1 g of EDTA inhibited absorption only partially. When administered 5 minutes after 2 g EDTA, Ca, Mg, and Sr ions counteracted the effect of EDTA completely; the effect of Zn was equivocal, and ferrous and ferric ions did not reduce EDTA inhibition. The results showed Ca, Mg, and Sr to be equally effective in counteracting EDTA. Since Zn has a much stronger affinity for EDTA than Ca, it is possible that part of EDTA-bound Ca was exchanged with Zn, making Ca available to absorption. Similar results were obtained with rat intestinal loops. When there was an interval between the dose of vitamin B_{12} and EDTA, about 3 hr in man and 45 min in the rat intestinal loop were necessary for the absorption to become unaffected by EDTA. (BBB)

22299 EFFECT OF RADIATION ON THE LIPID COMPOSITION OF RAT SERUM AND LIVER. Angelico, Raffaele (Istituto Superiore di Sanita, Rome); Casparrini, Giuseppe; Cavina, Guido; Moretta Maggiore, Lucia; Quintiliani, Marcello. Ann. Ist. Super. Sanita, 1: 698-707(1965). (In Italian).

Changes in serum and liver lipids after whole-body irradiation with a single massive dose of x rays were studied in adult male rats. The animals, after fasting for 12 hours, received the irradiation, with intensity of 44 R/min, for a total amount of 1000 R. The fasting animals were killed 48 or 72 hours after the irradiation. Unirradiated rats, kept in the same condition, served as controls. Total lipids were extracted with a chloroform-methanol procedure from pools of equal amounts of serum and liver of 3 or 5 rats. The separation of the various lipid components was accomplished by thin layer chromatography (TLC) on silica gel G (solvent system: hexane 65°-ethyl ether-acetic acid 80:20:1). Colorimetric determinations of cholesterol, di- and triglycerides and phospholipids, and a microtitolation of the free fatty acids were performed on the eluates from the TLC plate. The percent composition of the total fatty acids was obtained by gas-chromatographic analysis. A significant increase in total lipid content of the serum was observed either 48 hours or 72 hours after the irradiation, whereas liver lipids showed only minimal changes. The various factors of the serum lipids showed different changes. The hyperlipemia was mainly due to free and esterified cholesterol, phospholipids, and triglycerides which increased proportionally to the increase of total lipids; and diglycerides and free fatty acids showed only minimal changes. Liver lipid modification consisted in a decrease of triglycerides and cholesterol. (auth)

22300 SUGARS AND UNCOUPLING AGENTS AS INHIBITORS OF CESIUM UPTAKE BY EXCISED WHEAT ROOTS. Saddik, Kamel (Cairo Univ.); Stenlid, Goeran. Lantbrukshoegsk. Ann., 29: 241-6(1963).

Means were sought for inhibiting the uptake of ^{137}Cs by wheat plants. It was shown that the absorptions of ^{137}Cs ion and of chloride ion are affected in the same way by inhibitory sugars. On the other hand, the mechanisms of uptake for radiocesium and chloride ions differ in their reaction towards agents uncoupling oxidative phosphorylation. Of the 8 sugars tested, D-mannose and 2-deoxy-D-glucose inhibited the uptake of ^{137}Cs, whereas the other 6 had only slight effects. The results agreed with those obtained in experiments on chloride absorption. The inhibition caused by mannose or by 2-deoxy-D-glucose was reversed by glucose, sucrose, galactose, xylose, and fructose. The efficiency decreased in the order mentioned, glucose being the most active sugar. Pretreatment of the roots with aerated water for 24 hr greatly increased the capacity for absorption of ^{137}Cs. This also agreed with the effects on chloride absorption. At low concentrations, 2,4-dinitrophenol and salicylic acid stimulated the absorption of chloride, whereas higher concentrations were inhibitory. With nitrate and phosphate only inhibitions were observed. The uptake of ^{137}Cs was inhibited by the concentrations stimulating chloride absorption. It is concluded that the absorption of the metabolically inert ions cesium and chloride differs not only with respect to specific interactions with carriers but also in the reaction towards agents uncoupling oxidative phosphorylation. (BBB)

22301 BEHAVIOR OF SOME METABOLIC AND ENZYMATIC ACTIVITIES OF HEPATIC TISSUE IN ANIMALS SUBJECTED TO A CYCLE OF RADIATION. Pagani, G. (Ospedale Civile, Piacenza, Italy). Arch. Med. Interna, 16: 237-44(Sept.-Oct. 1964). (In Italian).

Changes in liver metabolism and enzyme activities were determined in rats subjected to 50 R whole-body doses of 180-kV x rays every other day, with shielding of the abdominal region. Groups of animals were given 4, 6, or 8 exposures and then sacri-

ficed, and a 4th group was sacrificed 10 days after 8 exposures (groups I, II, III, and IV, respectively). Oxygen consumption of liver decreased in all 4 groups, most markedly in group III, in which it fell to ½ normal. Anaerobic glycolysis was slightly decreased in groups II and III. The following liver enzyme activities were found in controls and groups I to IV: succinic dehydrogenase 9.5, 9.0, 7.7, 4.6, 7.9 units; malic dehydrogenase 470, 465, 401, 270, 403 units; glutamic-oxaloacetic transaminase 110, 109, 101, 94, 104 units; glutamic-pyruvic transaminase 19, 18, 14, 13, 16 units; lactic dehydrogenase 380, 373, 351, 306, 360 units; and aldolase 9.2, 9.1, 7.7, 6.3, 8.5 units. It is evident enzyme activities were depressed in the following order: group III > group II > group IV > group I. Thus the depression of liver metabolism was most marked immediately after the 400 R cumulated exposure. (BBB)

22302 ON THE COMPONENTS OF ^{85}Kr CLEARANCE CURVES FROM THE BRAIN OF THE DOG. Haeggendal, Egil; Nilsson, Nils Johan; Norbaeck, Bengt (Univ. of Goteborg, Sweden). Acta Physiol. Scand., 66: Suppl. 258, 5-25(1966).

For analysis of the type of composite curve obtained after intra-arterial injections of ^{85}Kr, desaturation curves of β radiation from the cortical surface and of γ radiation from the greater part of the brain were recorded simultaneously or in immediate succession. Also local micro-injections into different regions were used to identify the single components of the composite curves. The slopes of the β and γ components corresponded to each other in the two types of curves. Local microinjections of ^{85}Kr into the cortical grey matter resulted in mono-exponential clearance curves with the same slope as the fast phase of the composite γ or β curve, whereas curves from microinjections in the subcortical white matter had a slope corresponding to the slow phase of the composite curves. A third very slow phase of the composite γ curve was identified as due to flow in extracerebral tissue. In addition, an initial rapid phase was recorded in most curves after intraarterial injections and was assumed to be due to activity in the arterial blood. This phase was not present in clearance curves from blood drawn from the superior sagittal sinus, whereas the two main components representing blood flow in grey and white matter were identified. Some difficulties in the analysis of the composite clearance curves, especially concerning the slow component, are discussed. (BBB)

22303 TOXICITY OF SOME NEW CHELATING AGENTS FOR RADIOSTRONTIUM REMOVAL. Kostial, Krista; Maljkovic, Tea; Slat, Blanks; Weber, O. (Inst. of Industrial Hygiene, Zagreb). Arh. Hig. Rada Toksikol., 13: 295-8(1963).

The acute toxicity (LD_{50}) of intraperitoneal injections of the following compounds was compared in rats: EDTA (ethylenediaminetetraacetic acid), DTPA (diethylenetriaminepentaacetic acid), DIMEDTA (dimethylethylenediaminetetraacetic acid), PDTA (propylenediaminetetraacetic acid), HEDTA (N-hydroxylethylethylenediaminetriacetic acid). The respective LD_{50} values for these 5 chelating agents were 396.9, 665.6, 675.5, 356.6, and 337.0 mg/kg; or 1.06, 1.69, 1.89, 1.10, and 1.21 mM/kg. Thus, the toxicity of the recently synthesized compound DIMEDTA is almost equal to the toxicity of DTPA, both substances being less toxic than the other 3 complexing agents tested. LD_{50} values for PDTA were within the values found for EDTA. All of the tested chelating agents caused similar symptoms which were rapid in onset and became severe within about 10 min, with signs of distress and hypocalcemic convulsions. Death usually supervened within the first 2 hr. (BBB)

22304 UPTAKE, MOVEMENT, AND TRANSFER OF Rb, S, Cl, AND Fe THROUGH STOLONACEOUS PLANTS AS AFFECTED BY MOISTURE STRESS. Robertson, W. K.; Ammerman, C. B.; Dunavant, B. G. (Agricultural Experiment Station, Gainesville, Fla.). Soil Sci. Soc. Amer., Proc., 30: 473-7(July-Aug. 1966).

The movement of ^{86}Rb, ^{35}S, ^{36}Cl, and ^{59}Fe through a series of plants connected by segments of a single parent stolon as affected by moisture stress and the transfer of ^{86}Rb, ^{35}S, and ^{36}Cl from one plant to another when their roots were growing together in the same pot was studied in St. Augustine grass (Stenotaphrum secundatum). One-fourth of the ^{86}Rb and ^{35}S and one-half of the ^{36}Cl taken up by the plants from the soil moved through stolons to other plants. Rubidium-86, ^{35}S, and ^{36}Cl moved out of one plant into another growing in the same pot and then through stolons to additional plants. Stress conditions on the receptor stolon did not affect movement of the 3 elements to the same degree. The uptake ^{59}Fe from labeled $FeCl_3$, Fe_2O_3, $FeSO_4$, and $FeCl_3$ was low, amounting to 2.35, 0.70, 0.083, and 0.070%, respectively. For $FeCl_3$ the low percentage recovery was attributed to relatively high soil Fe and fixation. For the others it was probably due to low solubility. Uptake was so low for $FeSO_4$ that movement through stolons was difficult to measure. However for $FeCl_3$, Fe_2O_3, and $FeCO_3$ movement was dominantly towards new growth in every case similar to ^{86}Rb, ^{35}S, and ^{36}Cl. (BBB)

22305 URINARY 17-KETOSTEROID EXCRETION STUDY IN RADIATION-INDUCED MENOPAUSE IN BREAST CARCINOMA. Bhattacharyya, A. K. (Banaras Hindu Univ., Varanasi, India); Sirkar, D. Indian J. Cancer, 2: 210-12(Dec. 1965).

Radiotherapeutic sterilization in patients suffering from carcinoma of the breast, particularly in an advanced stage, should result in complete abolition of ovarian function. To assess the effect produced in the ovaries by radiation given by ^{60}Co teletherapy at a dosage between 1000 and 2500 rads to each ovary in one week, 17-ketosteroid excretion was studied in 11 patients before and 2 weeks after irradiation. In all these cases sterilization was carried out as a matter of routine and not because of the presence of advanced cancer locally or metastases. The individual doses were arrived at after ovarian function was assessed clinically from the menstrual and obstetric history of the patient and examination of endocrine function. In each of the 11 patients studied there was a reduction in the excretion of 17-ketosteroids, varying from 21 to 58% (average 37%) of the initial level. It is recommended that follow-up studies be performed on these patients as regards hormone secretion for extended periods, for estimation of 17-ketosteroids and individual fractions of estrogens to provide valuable information as regards the hormonal status of the patients in conjunction with clinical improvement. (BBB)

22306 STUDIES IN EXPOSURE OF ANADARA GRANOSA TO THE SECONDARY COOLANT (SEA-WATER) OF A NUCLEAR REACTOR. Naidu, J. R.; Doshi, G. R.; Shringarpure, S. G. (Atomic Energy Establishment, Trombay, India). Curr. Sci. (India), 36: 93-4(Feb. 20, 1967).

Sea water, used as the secondary coolant of the CIRUS nuclear reactor, contains an appreciable amount of ^{137}Cs at its outflow point. The fate of ^{137}Cs in the marine environment in the vicinity of the discharge point was investigated in the laboratory. A large population of Anadara granosa, a marine bivalve, commonly found in the region was exposed to the effluent and the resulting concentration of ^{137}Cs by the mollusks was studied with time. Results showed a high uptake of ^{137}Cs during the first 24-hr period with a slower rate of uptake during the next 8 days that resulted in a concentration factor of 85 by the 10th day. (C.H.)

22307 STUDIES ON THE ELIMINATION OF RADIOACTIVE STRONTIUM. 5. EFFICACY OF DELAYED TREATMENT WITH VARIOUS DRUGS. Ogawa, Eiichi; Suzuki, Shiro; Tsuzuki, Hiroshi (Gunma Univ., Maebashi, Japan). Gunma J. Med. Sci., 14: 125-30(June 1965).

Male mice of the ddN strain were subcutaneously injected with ^{85}Sr or ^{90}Sr, and the effects of delayed treatment with various drugs, given once daily for 2 or 3 days from the 8th day of Sr injection, on their retention on the 11th day were investigated. Among the chelating agents tested, BADE in combination with $MgCl_2$ or $SrCl_2$ displayed Sr-eliminating effects, but Ca EDTA, BADE, Na DTPA, Na citrate, NaCa citrate, NaMg citrate, NaSr citrate, and NaPb citrate were not effective. Sodium hexamethaphosphate, conversely, exerted in inhibitory effect. Tetracycline alone or combined with $MgSO_4$ was not effective. Also, MgK aspartate alone or combined with NH_4Cl was ineffective. Of the salts tested $MgCl_2$ and NH_4Cl had a Sr-eliminating effect at certain doses but were ineffective in higher doses; $MgSO_4$, $Na_2S_2O_3$, Na polyphosphate, $CaCl_2$, and Ca gluconate were all ineffective. Of the hormones examined, glucocorticoids, which were effective in early treatment, produced no effect in delayed treatment, as did thyroxine and antithyroid drugs. Parathyroid extracts either alone or in association with chelating agents such as Na citrate, NaCa citrate, and BADE were ineffective, as was growth hormone. These results were obtained by injection of the drugs. When given orally as 1% solutions, no effect was seen with Na polyphosphate, ferric ammonium citrate, NH_4Cl (in combination with Ca EDTA), and ion exchange resin (Amberlite XE-69). Once deposited in bone, radiostrontium cannot be eliminated as easily as in early treatment. (BBB)

22308 WHOLE-BODY RETENTION OF ^{137}Cs IN SUCKLING AND WEANLING MICE. Matsusaka, N.; Inaba, J. (National Inst. of Radiological Sciences, Chiba, Japan). Nature, 214: 303-4(Apr. 15, 1967).

In view of the scarcity of data on the retention of ^{137}Cs in young animals, a study was undertaken using young mice. An "Armac" liquid scintillation detector was employed as a small animal whole-body counter. The ^{137}Cs was administered in oral doses in saline solution. Allowances were made for contamination caused by mother's milk and natural contact. Results were tabulated and plotted. An unusual retention pattern was found for sucklings. In weanlings, retention decreased exponentially. Adult animals showed a slower decrease. Whereas weanlings showed a biological half-life of 1.8 days, the value for sucklings was 7.5 days. Similar re-

sults for sucklings were obtained with ^{86}Rb. Results suggested that the rate of excretion in sucklings was slow during breast feeding, became faster when near weaning, and after weaning was almost the same as for weanlings. (UK)

22309 EFFECT OF PREDNISOLONE ON THE PHYTOHEMAGGLUTININ-INDUCED RADIORESISTANCE AND BLASTOID TRANSFORMATION OF HUMAN LYMPHOCYTES IN VITRO. Stefani, S.; Oester, Y. T. (Veterans Administration Hospital, Hines, Ill. Loyola Univ., Chicago). Transplantation, 5: 317-22 (Mar. 1967).

The blastoid transformations and radioresistance produced by phytohemagglutinin (PHA) in human blood lymphocytes in vitro are suppressed by prednisolone when introduced 24 hours before PHA. This corticosteroid, under the same conditions, maintains a cytotoxic effect on lymphocytes. Each of the above effects is reduced or lost when the corticosteroid is introduced after PHA. The possible implications of these findings on tissue transplantation are discussed. (auth)

22310 AMIDE GROUPS OF BRAIN PROTEINS IN LESION BY PENETRATING RADIATION AND OVERCOOLING. Voronina, N. P.; Veksler, Ya. I. (Rostov-on-Don State Univ., USSR). Ukr. Biokhim. Zh., 39: No. 5, 25-8(1967). (In Russian).

The authors studied the dynamics of the amide groups of brain proteins (total and water-soluble) in albino rats, subjected to total irradiation with ionizing radiation (600 R), as well as in the case of the joint action of penetrating radiation and overcooling (up to 19–20°C). In the process of development of radiation sickness there is a reduction in the brain protein amide group content. These changes are distinctly manifested in the latent period of the disease, and by the 30th day they are normalized. In the irradiated animals subjected to artificial hypothermy there are no changes typical of overcooling in the amide group content. Decrease in body temperature of the irradiated animals up to 20°C does not affect the amidation of brain proteins. (auth)

22311 RAT EPIPHYSEAL CARTILAGE. IV. EFFECT OF PAPAIN ON PROTEINPOLYSACCHARIDE METABOLISM AND ^{35}S INCORPORATION, IN VITRO AND IN VIVO. Guri, Charles D.; Bernstein, Daniel S. (Harvard Univ., Boston. Peter Bent Brigham Hospital, Boston. Robert Breck Brigham Hospital, Boston). Proc. Soc. Exp. Biol. Med., 124: 380-6(Feb. 1967).

The effect of papain on rat epiphyseal cartilage (REC) mucopolysaccharide (MPS) and ^{35}S MPS incorporation has been studied in vitro. Papain treatment, both in vivo and in vitro, has been demonstrated to have a greater effect on the water-soluble fraction (proteinpolysaccharide) of the total MPS from this tissue. Small doses of papain, administered in vivo, were associated with an increased ^{35}S MPS incorporation, evident within 6 hr and present up to 24 hr. These studies suggest that extracellular alterations of MPS in their physiologic state (protein complexes) have affected the biologic processes and matrix integrity of REC. (auth)

22312 INFLUENCE OF DIFFERENT SALT COMPOSITION OF WATER ON ^{137}Cs ACCUMULATION AND EXCRETION IN FRESH WATER FISH. Lebedeva, G. D. Radiobiologiya, 6: 556-9(1966). (In Russian).

The maximum accumulation of the radioisotope ^{137}Cs at a specific activity in water of 1×10^{-7} Ci/l occurs in the muscle tissue of fresh water fish (carp yearlings) after one to two months and in the bone tissue after 2.5 to 3 months. The intake of ^{137}Cs by fresh water fish can be reduced by 2 to 7 times in water supplemented with K and Na. The biological and effective half-life of ^{137}Cs in carp yearlings for muscle tissue is six days and for bones 15 days. (tr-auth)

22313 CALCIUM MOVEMENT IN OAT LEAVES MEASURED BY SEMICONDUCTOR DETECTORS. Ringoet, A.; Rechenmann, R. V.; Veen, H. (EURATOM-ITAL, Wageningen, Netherlands). Radiat. Bot., 7: 81-90(Apr. 1967).

The movement of ^{45}Ca, applied locally at the surface of young leaves of oat plants, was studied by in vivo counting with β-sensitive semiconductor detectors. The results are compared with those obtained by liquid scintillation counting. The initial penetration of calcium into the tissue is a slow process. Absorbed calcium moves first and mainly in an acropetal direction. Downward movement only occurs at higher concentration of the applied calcium solution (>0.02M $CaCl_2$) and is somewhat delayed in relation to the upward movement. At high concentration of the foliar-applied solution (>0.03M $CaCl_2$) the amounts of calcium absorbed in the tissue underneath the application site and translocated to the leaf tip increase almost proportionately with the concentration. Uptake, as well as upward transport in the lower concentration range of the foliar-applied solutions, and downward movement at all concentrations are less strictly concentration dependent. Transport of calcium probably takes place in the conducting tissue. From adsorption sites in this tissue calcium is readily redistributed over the mesophyll and epidermis cells. Upward and downward transport velocities of 30 to 75 and 15 to 30 cm/hr, respectively, were recorded. (auth)

22314 TRANSLOCATION OF CARRIER-FREE ^{85}Sr APPLIED TO THE FOLIAGE OF WOODY PLANTS. Handley, R.; Schulz, R. K.; Marschner, H.; Overstreet, R.; Longhurst, W. M. (Univ. of California, Berkeley). Radiat. Bot., 7: 91-5(Apr. 1967).

Carrier-free ^{85}Sr was applied to the foliage of three genera of woody forage plants (Ceanothus, Adenostoma, and Quercus) and subsequent translocation into untreated portions of the plants was measured. Experiments were conducted in the field and in the greenhouse. In all cases the bulk of the retained activity remained in the directly treated material. Substantial concentrations of ^{85}Sr were, however, found in the new growth arising on previously treated branches of Ceanothus and Adenostoma. The amounts translocated under field conditions, where plants were subject to periodic wetting and drying, were greater than those translocated by plants in the greenhouse. (auth)

22315 METHOD FOR ENHANCEMENT OF ELECTRON MICROSCOPIC VISUALIZATION OF EMBEDDED ANTIGEN BY BRIDGING OSMIUM TO URANIUM ANTIBODY WITH THIOCARBOHYDRAZIDE. Sternberger, Ludwig A.; Hanker, Jacob S.; Donati, Edward J.; Petrali, John P.; Seligman, Arnold M. (Medical Research Labs., Edgewood Arsenal, Md.). J. Histochem. Cytochem., 14: 711-18(Oct. 1966).

Antibodies can be rendered electron-opaque without an appreciable increase in size by uranyl ion, which chelates strongly with protein. However, extensive combination of uranyl ion with antibody destroys its immunologic reactivity. This destruction presumably is due to reaction of uranyl ions with the specific combining sites of the antibody molecule rather than to reaction with the nonspecific regions. To prevent destruction of antibody reactivity, the antibody-combining sites are protected by reaction with an insoluble form of antigen prior to exposure to U. Although uranium-labeled antibody localized antigen on ultrathin tissue sections specifically, further improvement in contrast, resolution, and stability in the electron beam was attempted by bridging metals with ligands such as thiocarbohydrazide (TCH). On application to sections containing tissue-bound cations, one arm of TCH was found to bind with the U in the section, leaving the other arm free to react with osmium tetroxide to produce osmium black at the sites of the tissue-bound cations. On sections in which acrolein-fixed antigen had been localized for electron microscopy by U antibody, application of TCH followed by osmication greatly enhanced the specific contrast afforded. In addition, this procedure yielded better resolution and better stability to the electron beam than the immunouranium technique employed without this intensification. Even osmium tetroxide-fixed tissue could be used, providing thiosemicarbazide was employed to block the later reaction of TCH with tissue-bound Os and to limit, thereby, the ligation of TCH to the U-labeled antibody. (BBB)

22316 VARIETY DIFFERENCES IN STRONTIUM AND CALCIUM ACCUMULATION IN SEEDLINGS OF BARLEY. Young, W. I.; Rasmusson, D. C. (Univ. of Minnesota, St. Paul). Agron. J., 58: 481-3(Sept.-Oct. 1966). (COO-1097-18).

Intraspecific differences in Ca and Sr accumulation in seedling plants of barley, Hordeum vulgare, were studied. In 16 varieties the effects of Ca/Sr ratio, pH, and various ^{89}Sr concentrations and durations of feeding were evaluated. Significant differences were observed for Ca and Sr accumulation among varieties of barley seedlings grown in nutrient solution. Varieties high in Sr accumulation also were high in Ca accumulation. Two-fold differences in accumulation were observed for both Ca and ^{89}Sr. The ratio of Ca to Sr in the nutrient solution had little effect on variety differences in accumulation of Ca or Sr. However, there was evidence that varieties differed in ratio of Ca to Sr accumulated in the shoots. The pH of the solution did not affect total ^{89}Sr accumulation or variety differences. Both concentration and duration of feeding had a marked effect on total ^{89}Sr accumulation, but no effect on variety differences. (BBB)

22317 EFFECT OF OPERATION ON KIDNEY FUNCTION AND ON THE BEHAVIOR OF A TRACER DOSE OF ^{85}Sr IN TWO PATIENTS WITH HYPERPARATHYROIDISM AND SEVERE HYPERCALCEMIA. Coenegracht, J.; Dorleyn, M. (St. Annadal Hospital, Maastricht, Netherlands). Acta Endocrinol., 53: 245-55(Oct. 1966).

Radiostrontium metabolism was studied in 2 cases of severe hypercalcemia due to parathyroid adenoma. In both cases an unexpected difference in the alteration of the serum and urinary concentrations of ^{85}Sr and stable Ca was observed after operation. In 1 case a secondary max was seen in the sp act.-vs-time

curve for ^{85}Sr level in serum 15 days postinjection. The observed break and enrichment of the exchangeable pool in this case may be due to resorption of bone with a short-life span independent of the operation. It is also possible that back-diffusion of ^{85}Sr from the skeletal mineral stores to the rapidly exchangeable compartment had taken place, leading to a rise in the serum ^{85}Sr concentration. In the second case, although a slight break in the concentration curve occurred spontaneously after 7 days, due to either resorption of short-lived bone or to backdiffusion, a steep rise was observed immediately after operation which seemed directly related to the surgical intervention. Therefore it is likely that the rise in the first case was largely an effect of the operation. As the rapid decrease in serum and urine calcium could only be due to a high bone accretion rate, it would be expected that if the skeleton does not discriminate between ^{85}Sr and Ca, this high accretion rate would have caused a reduction in the ^{85}Sr concentration instead of the observed rise. Apparently a considerable part of ^{85}Sr was not yet incorporated into the deeper layers of the bone crystals and was flushed out by the large amount of Ca entering the bone after operation. Other investigators have also found that the skeletal clearances of Sr and Ca are not completely identical and it is likely that this difference becomes more manifest when the bones have a high avidity for Ca. The postoperative change in bone accretion rate cannot be estimated from ^{85}Sr data. (BBB)

22318 DETERMINATION OF BASE RATIOS OF THE EARLY AND LATE MESSENGER RNA BACTERIOPHAGE T2 UNDER THE DIFFERENT CONDITIONS. Kitazume, Yoshiji (Kobe Univ., Japan). Mem. Coll. Sci., Univ. Kyoto, Ser. B, 22: 185-97 (Mar. 1966).

Base ratios of peaks of the T2 phage specific (messenger) RNA under different conditions were separated by a chromatography on a MAK column. The different conditions were use of partially damaged uv-irradiated phages, treatment with CM at the early period after phage infection, uracil starvation, uracil replacement by fluorouracil, and replacement of tryptophane with azatryptophane during the development of phage particles. Base ratios of the mRNA's obtained under the given conditions all resembled those of phage DNA. The properties of the phage specific mRNA's are briefly discussed. (NSA of Japan)

22319 IODINE METABOLISM IN YOUNG CHINOOK SALMON (ONCORHYNCHUS TSCHAWYTSCHA, WALBAUM). I. THYROIDAL IMPAIRMENT WITH THE USE OF ^{131}I. La Roche, Gilles (Univ. of Rhode Island, Narragansett); Johnson, C. L.; Woodall, A. N. Gen. Comp. Endocrinol., 7: 512-24(Dec. 1966).

Six monthly or 6 weekly injections of 100 $\mu Ci^{131}I$ (as carrier-free iodide) (total dose 600 μCi/fish) produced a profound impairment of thyroid function in yearling chinook salmon. Thyroid region ^{127}I contents, radioiodine turnover studies, and modifications in iodinated metabolite contents were the principal functional parameters examined. Histological examinations revealed that thyroid follicle destruction was not accompanied by an arrest of thyroxine synthesis. Preliminary microscopic and biochemical evidence also indicated that thyroid epithelial cell integrity is not a condition essential for thyroxine biosynthesis. At least 9 months after the disappearance of thyroid follicles detectable levels of thyroxine were produced. This amount appeared sufficient to maintain growth at a rate indistinguishable from that of controls. None of the peripheral changes described for young ^{131}I-treated rainbow trout were observed in young chinook salmon in spite of highly significant decreases in thyroid region ^{127}I. It was concluded that ^{131}I destruction of functional thyroid elements is more difficult to achieve in the yearling chinook salmon than in the rainbow trout of the same age. (BBB)

22320 TRANSFER OF ^{85}Sr THROUGH PLACENTA AND MOTHER'S MILK. I. Matsusaka, Naonori; Ikeda, Miyoshi; Ohkubo, Yoshio (Tokyo Univ.). Nippon Juigaku Zasshi, 28: 315-20(Dec. 1966). (In Japanese).

The transfer of ^{85}Sr from mother to the fetus through the placenta during intrauterine life and via mother's milk during nursing was studied in mice. Three groups of female mice were injected intraperitoneally with 2 μCi of ^{85}Sr in 0.5 ml saline solution as a single tracer dose and mated at different intervals after injection. The amounts of ^{85}Sr accumulated in the young at birth were 0.087, 0.067, and 0.047% of the dose in those derived from mice mated 1 to 2, 2 to 3, and 4 to 5 weeks after ^{85}Sr injection, respectively. It was apparent that the shorter the interval between injection and parturition, the greater the ^{85}Sr content in the young at birth. In the newborn of ^{85}Sr-contaminated mothers nursed with breast milk the accumulation of ^{85}Sr increased rapidly on the 3rd day after birth. The ^{85}Sr retained by the suckling mice was derived partially from placental transfer and partially from mother's milk. The relative contributions from the transplacental and milk-borne ^{85}Sr taken up by the suckling mice during the nursing period were calculated. The contribution of transplacental ^{85}Sr decreased rapidly after birth, while that of milk-borne ^{85}Sr increased during nursing. (BBB)

22321 BLOOD LOSS DURING HOOKWORM INFECTION, DETERMINED BY ERYTHROCYTE LABELING WITH RADIOACTIVE ^{51}Cr. I. INFECTION OF DOGS WITH NORMAL AND WITH X-IRRADIATED ANCYLOSTOMA CANINUM. Miller, T. A. (Univ. of Glasgow Veterinary Hospital, Bearsden, Scot.). J. Parasitol., 52: 844-55(Oct. 1966).

In experiments designed to investigate the immune responses of dogs following vaccination with x-irradiated A. caninum larvae, the blood loss caused by hookworms at various stages of the infection was determined with ^{51}Cr. The larvae were irradiated with 40-kR doses. Significant changes in the urinary excretion of ^{51}Cr were not detected at any time during infection. Blood loss in the feces was first detected on the 8th day after inoculation of infective larvae, except in adult dogs (10th or 11th day) and in pups with light infections of x-irradiated worms (10th day). Blood loss in the feces reached a maximum between 12 and 16 days after inoculation with a second peak in the pups at 23 to 25 days. Pups infected with less than 30 normal adult A. caninum per lb body weight experienced significantly greater fecal blood loss per worm per day than pups infected with more worms, although the pups infected with the greater numbers of worms experienced greater total fecal blood loss per day. The hematologic findings reflected the fecal blood loss results during infection with normal A. caninum. Infection with x-irradiated A. caninum, even with relatively large infections (more than 30 worms/lb body weight), failed to induce adverse hematologic changes in the infected pups in spite of the occurrence of blood loss during such infection. (BBB)

22322 NEGLIGIBLE EFFECTS OF X-RADIATION OF THE HEAD UPON HEARING IN THE RAT. Murphy, Jerome E.; Harris, J. Donald (Shilling Auditory Research Center, Inc., Groton, Conn.). J. Aud. Res., 1: 117-32(Jan. 1961).

Three-month-old rats were trained to press a lever for food during the periods when an otherwise constant tone of 4 kcps was modulated in a sinusoidal fashion, either 4 db in intensity or 4% in frequency. Other rats were trained to respond in a shuttlebox to the onset of modulation. At a stage in this acquisition curve, individual rats were given a single x-ray dose of 200 R directed toward the rear half of the skull. No effect on the learning curves could be observed, whereupon the dose was changed to 500 R. Rats given this larger dose were able to maintain both lever-pressing and shuttlebox habits, though a few days after x irradiation at 500 R the shuttlebox habit showed some deterioration for both types of modulation. A dose of 500 R had no effect on the audiogram as measured by the Preyer pinna reflex, nor upon the 1 $\mu\nu$ cochleogram as compared with the average normal untreated rat. If a deterioration occurred in the shuttlebox situation, the effect was not primarily on the peripheral sense organ. The results show that auditory function is relatively insensitive to ionizing irradiation in the sublethal range. (BBB)

22323 SUPPRESSION OF HYDRATE AND DIMER FORMATION IN ULTRAVIOLET-IRRADIATED POLY (A + U) RELATIVE TO POLY U. Pearson, Mark (Stanford Univ., Palo Alto, Calif.); Johns, H. E. J. Mol. Biol., 20: 215-29(Dec. 1966).

Radiophosphorus-labeled poly U and poly (A + U) (adenylic + uridylic acids), containing a 1:1 mixture of poly A and ^{32}P-poly U, were irradiated at 280 mμ to study the influence of secondary structure on photoproduct formation in the uracil residues. Samples were removed as a function of exposure, hydrolyzed to completion with RNase, and chromatographed to give U, H, DU, and DH as the major products. (H = hydrate of 3'-uridylic acid; DU = a trinucleotide of uridylic acid with the first 2 nucleotides as a dimer and the last nucleotide as unaffected uridylic acid.) The rates of formation of DU and H photoproducts in poly U and poly (A + U) were compared. The rate of hydration in poly (A + U) is suppressed by a factor of 10 relative to poly U. The rate of DU formation in poly (A + U) is one-fifth that of poly U. These results provide a direct proof of the importance of secondary structure in determining the photochemical behavior of U in polynucleotides. In addition, the kinetics of product formation in poly (A + U) leads to postulation of a localized melting of H bonds in the region of dimers. (BBB)

22324 ON THE METABOLISM OF THOROTRAST AND ITS DAUGHTERS IN THE SM MICE AND ESTIMATION OF RADIATION DOSAGE ON THE HUMAN AFTER INTRAVENOUS INJECTION OF THOROTRAST. Ogawara, Shigeyuki (Nagasaki Univ.). Nagasaki Igakkai Zasshi, 41: 37-55(Jan. 1966). (In Japanese).

Inner radiation doses received from thorotrast deposited in organs of the body and the metabolism of thorotrast and its daughter

nuclides were investigated. Thorotrast in the amount of 0.1 cc or 0.5 cc was intravenously injected into SM mice. At various intervals postinjection, mice were sacrificed and the intensity of γ rays in each removed organ was measured. The intensity of γ rays in the same organs was measured over a 30 day period. Build-up curves were plotted from the data obtained. Following completion of the build-up curves, the quantity of ThO_2 and its daughter nuclides in each organ was determined. Five months after injection it was found that 19.9% of the ThO_2 was excreted; 86% of the ThO_2 remaining in the body was present in the liver, spleen, and bone at a ratio of 67:22:11, respectively. The amount of daughter nuclides excreted by the liver and spleen over a 5 month period was found to be 76 to 79% for each. The amount of daughter nuclides in the bone increased ~130%; the increase was attributed to redeposition of nuclides excreted by other organs. As for the metabolism of ThO_2 and its daughter nuclides, no difference was noted between mice receiving 0.1 cc of thorotrast of those receiving 0.5 cc. Inner radiation doses were estimated from build-up curves. It was found that the estimated absorbed doses taken from these data were much smaller than those previously reported. (auth)

22325 CHANGES IN INCLUSION OF GLYCINE-2, ^{14}C, AND ^{45}Ca INTO CALCIFIED TISSUES BY REPEATED ^{32}P INJECTION. Prokhonchukov, A. A. (Central Scientific-Research Inst. of Stomatology, Moscow). Radiobiologiya, 6: 619-21(1966). (In Russian).

The effects of the total dose of ^{32}P of 1 mCi/g cause much greater changes in the inclusion of glycine-2 ^{14}C and ^{45}Ca in calcified tissue than ^{32}P introduction with total doses of 0.5 mCi/g. Not only the quantitative but the qualitative dependency of the character of the inclusion of glycine-2 ^{14}C and ^{45}Ca in calcified tissue is explained by the size of the ^{32}P dose. In bones very high doses of ^{32}P cause a reduction and in teeth, especially incisors, an increase of the level of inclusion of glycine-2 ^{14}C and ^{45}Ca. Changes in the inclusion processes for glycine-2 ^{14}C and ^{45}Ca are expressed to a greater degree in bones than in teeth. Disturbances of the inclusion process for glycine-2 ^{14}C in albumin are found to a greater degree than ^{45}Ca in the mineral fraction of calcified tissue. Disturbances of the inclusion process by glycine-2 ^{14}C and ^{45}Ca arise long before the appearance of morphological changes of the calcified tissue and increase to a degree the depression of structural changes. The character and the basic regularities of the changes of the inclusion of glycine-2 ^{14}C and ^{45}Ca in calcified tissues under the effects of multiple introduction of ^{32}P into the organism, begun in basic analogy with the disturbances under single injection of ^{32}P, display some peculiarities. Under repeated injection of ^{32}P, it was not possible to detect activation of the inclusion processes of glycine-2 ^{14}C and ^{45}Ca. The observed changes evolved very slowly and had a very stable character. (tr-auth)

22326 EFFECTS OF MONOETHANOLAMINE ON THE OXIDATION PROCESSES IN IRRADIATED TISSUE. Babina, E. Ya. (Erevan Zootechnical Veterinary Inst.). Dokl. Akad. Nauk Arm. SSR, 42: 31-5(1966). (In Russian).

White male rats weighing 150 to 200 g were injected intraperitoneally with monoethanolamine and exposed to 650 R of whole-body radiation. The results showed that the radiation increased the amount of lipid peroxides and inhibited respiration of the liver and spleen tissues. Treatment with monoethanolamine about 7 to 10 min before exposure reduced the content of lipid peroxides in the liver and spleen. The most pronounced reduction of lipid peroxides was observed in the liver on the fourth or fifth day of radiation sickness and in the spleen on the fourth to sixth day. The reduced content of lipid peroxide and increased tissue respiration due to monoethanolamine indicate the feasibility of using it for radioprotection of white male rats. (R.V.J.)

22327 BIPHASIC INCREASE IN CORTICOSTEROIDS OF ADRENALS AND BLOOD OF RATS AFTER WHOLE-BODY RADIATION. Flemming, K.; Hemsing, W.; Geierhaas, B. (Heiligenberg-Institut, Ger. Univ., Freiburg i. B.). Z. Naturforsch., 22b: 85-90(Jan. 1967). (In German).

Whole body x radiation of rats led to a biphasic increase in the corticosteroid content of the adrenal glands, of the venous blood of the adrenal gland, and of the peripheral blood. The first phase began about one hour after radiation and was clearly discernible after 2.5 hours. After a temporary normalization period, the second increase was detectable after 72 hours. It was considerably larger than the first. The changes in adrenal and blood corticosteroids changed in parallel; there was no indication of inhibition of adrenal secretions. Ether narcosis increased the corticosteroid level in the blood. Sham irradiation of rats caused a significant increase in the corticosteroids of peripheral blood, but not of the adrenal gland. This effect was not found in previously accustomed animals. The results show no indication of a drop in corticosteroids in the blood and adrenal gland after whole body x ray exposure. (auth)

22328 SULFUR MUSTARD AND X RAYS: DIFFERENCES IN EXPRESSION OF LETHAL DAMAGE. Mauro, F.; Elkind, M. M. (National Cancer Inst., Bethesda, Md.). Science, 155: 1561-3(Mar. 24, 1967).

Before or after treatment with sulfur mustard, simple changes in the incubation conditions of cultured Chinese hamster cells lead to changes as great as a factor of 6 in survival-curve slopes. With x ray treatment, changes are similar but much smaller in magnitude. These results suggest that the modes of action of these agents are not entirely the same. (auth)

22329 DEOXYRIBONUCLEASE I ACTIVITY IN URINE OF IRRADIATED RATS TREATED WITH CYSTAMINE. Libikova, N. I. (Military Medical Academy, Leningrad). Radiobiologiya, 6: 583-6(1966). (In Russian).

Single whole body irradiation of rats with x rays at doses of 700 and 350 R cause a persistent increase of the DNAase I activity in the urine. The injection of cystamine to a significant degree reduces the changes DNAase I activity in the urine after irradiation at 700 R and completely normalizes it after irradiation at doses of 350 R. (tr-auth)

22330 INVESTIGATION OF RECOMBINATION OF FREE RADICALS IN IRRADIATED PROTEINS. L'vov, K. M. (Inst. of Biological Physics, Moscow). Biophysics (USSR)(Engl. Transl.), 10: 235-40(1965).

Translated from Biofizika, 10: 212-16(1965).

The annealing curves representing the dependence on temperature of the steady concentration of paramagnetic centers were obtained for nine γ- and uv-irradiated proteins including silk fibroin, native and denatured egg albumin, procollagen, serum albumin, pepsin, trypsin, protamine, and hemaglobin. The electron paramagnetic resonance spectra show that the primary structure of the proteins, amino acids, does not influence the recombination of free radicals whereas the form of the protein molecule is hypothesized to be important with regard to free radical recombination. It is concluded that the effects of γ and uv radiations are identical if the protein is able to absorb the uv. (R.E.U.)

22331 ANALYSIS OF SOME FEATURES OF ERYTHROPOIESIS IN DOGS FOLLOWING RADIATION SICKNESS. Ziadinova, O. F. Radiobiologiya, 6: 549-51(1966). (In Russian).

Dogs were irradiated with γ doses of 300 RAD and two weeks later with a second dose of 300 RAD. Thirty eight days later the erythropoiesis cycle in the dogs was determined, both in fresh blood and in blood incubated for one and a half and three hours. The results showed that the maturation rate of reticulocytes in the incubated blood of animals having radiation sickness was significantly lower than the levels obtained before irradiation. After 38 days the depression in the intensity of the erythropoiesis remained and the significance of these results is discussed. (J.S.R.)

22332 DEFINITION OF THE VALUE OF ^{90}Sr ABSORPTION THROUGH THE INTESTINES. Sarapultsev, I. A. Radiobiologiya, 6: 552-5(1966). (In Russian).

The movement of ^{90}Sr in the organism after oral and parenteral introduction of the isotope is outlined. The two methods for determining the absorption coefficient of ^{90}Sr were outlined. The results obtained by both methods were compared in experiments made on dogs. The advantages of the oral and subcutaneous methods are discussed. (J.S.R.)

22333 SOFT X-IRRADIATION INFLUENCE ON THE CONTENT AND BIOSYNTHESIS OF DNA IN TISSUES OF MICE. Orlov, A. S. (Inst. of Radiation Protection, Leningrad). Radiobiologiya, 6: 500-2(1966). (In Russian).

The irradiation of mice with soft x rays at sublethal doses (1,530 R with effective energy of 10 keV) in the stomach produced a depression of the biosynthesis of DNA, characteristic of radiation sickness, and decrease of its concentration in the small intestine and the skin of the stomach. In the skin of the back the biosynthesis of DNA increased some during the course of several days. Hard x irradiation in sublethal doses (520 R with an effective energy of 75 keV) has greater depressive effect on the biosynthesis of DNA in the small intestine and the skin of mice than soft x irradiation at sublethal doses of 1,530 R. (tr-auth)

22334 CHANGE OF MECHANICAL AND ELECTRICAL PROPERTIES IN MONOMOLECULAR FILM OF LIGHTLY IRRADIATED CRYSTALLINE MYOSIN. Nadareishvili, K. Sh.; Egiazarova, A. R. (Inst. of Physiology, Tbilisi, USSR). Radiobiologiya, 6: 503-9(1966). (In Russian).

X irradiation of solutions of myosin A at concentrations of 5,

12.5, and 35 mg/ml at doses of 20, 50, and 100 R causes a reduction of the surface tension and elasticity as well as of the area and surface potential jump in monomolecular films of irradiated protein. With increase of the concentration of the protein from 5 to 35 mg/ml an increase of the effect is observed. Secondary effects were not observed for 24 hours at the dose and dose outputs used. (tr-auth)

22335 DNA SYNTHESIS IN THE CULTURE OF UV-IRRADIATED CELLS. Terskikh, V. V. (Inst. of Molecular Biology, Moscow). Radiobiologiya, 6: 510-5(1966). (In Russian).

UV irradiation at doses of 100 to 500 erg/mm^2 causes an immediate suppression of the synthesis of DNA in human cell cultures of the A-1 and FL strain. The suppression of the synthesis of DNA occurs in all cells. In A-1 cell cultures data show that the reduction of the DNA synthesis continues to be increased during several days after irradiation, after which a recovery of the synthesis of DNA is observed. In addition to the suppression of the DNA synthesis UV irradiation has the capacity to induce incorporation of labeled thymidine into the DNA nucleus. The latter process is significantly weaker. The introduction in the DNA molecule of bromouracil increased the sensitivity of DNA synthesis to irradiation. (tr-auth)

22336 X IRRADIATION INFLUENCE ON THE DISTRIBUTION OF AMINO ACIDS AMONG ERYTHROCYTES AND PLASMA. Fridlyand, I. B.; Kubareva, M. M. (State Scientific-Research Inst. of Roentgen-Radiology, Moscow). Radiobiologiya, 6: 516-8 (1966). (In Russian).

The capacity of erythrocytes for the accumulation of amino acids at different stages of radiation sickness of the organism was investigated in white rats and guinea pigs. One group of animals was exposed to lethal irradiation doses, 500 R for the guinea pigs and 1,000 R for the rats. In other groups chronic radiation sickness was induced in the animals by daily doses of 40, 20, and 10 R in rats. The results are tabulated and show that irradiation causes a significant disruption in the distribution in the aminonitrogen between the erythrocytes and blood plasma of all animals. As a result of the development of radiation sickness there is an increase, and in the terminal stages of the illness, a decrease of the capacity of erythrocytes to accumulate amino acids. (tr-auth)

22337 PENETRATING RADIATION EFFECTS ON CYTOCHROMOXIDASE OF SMALL INTESTINES IN MICE. Strelina, A. V. (Central Scientific-Research Inst. of Roentgen-Radiology, Leningrad). Radiobiologiya, 6: 519-23(1966). (In Russian).

Histochemical data showed regular changes in the activity of the cytochromoxidase in the small intestine after whole body irradiation of mice with x ray doses of 0.6, 2, and 4 kR. Immediately after the irradiation at all doses a depression of the activity of the cytochromoxidase was observed. Within one hour at 0.6 kR and at two hours at 4 kR the activity of the cytochromoxidase was normalized, after 24 hours it again decreased and after 48 to 72 hours at 4 kR was progressively depressed. The earlier effect of the depression of the cytochromoxidase activity was probably explained by the direct effect of the radiation on the ferment since the sensitization of the decrease of the cytochromoxidase was observed by the effects of cyanide on the irradiated organism. Cyanide intensifies the succinate nitro-ST reductase activity, which was explained by the blocking effect of cyanide on the cytochromoxidase. (tr-auth)

22338 STATISTICS OF PROBABLE DISTRIBUTION OF ^{90}Sr. AND OF SOME REACTIONS OF ORGANISMS BY SINGLE AND CHRONIC PENETRATION OF ^{90}Sr. Shvedov, V. L.; Panteleev, L. I.; Panchenko, I. Ya.; Grebenyuk, N. G.; Goloshchehapov, P. V. Radiobiologiya, 6: 524-8(1966). (In Russian).

Statistical values of distribution of Sr-90 in the diet and skeleton of mice are described with a 90% reliability as a function of the normal distribution. The quantitative indices of the peripheral blood, chromosome ruptures, weight of the spleen, and body weight of the mouse after introduction of ^{90}Sr were also described as functions of the normal distribution. Statistical processing of the material obtained during single and chronic introduction into the animal on the experimental level can be derived on the basis of the normal distribution law. (tr-auth)

22339 EARLY DISTURBANCES OF WATER METABOLISM THROUGH LUNG BARRIER OF ANIMALS BY IRRADIATION. Kachur, L. A.; Shutko, A. N.; Abroskina, T. I. (Central Scientific-Research Inst. of Roentgen-Radiology, Leningrad). Radiobiologiya, 6: 529-33(1966). (In Russian).

The probability of changes in the permeability of the lung barrier and the appearance of disturbances in the kinetic regularity of water exchange and water balance soon after irradiation of animals with x rays at different doses was investigated. Heavy water was used as the indicator in the measurement of the water exchange. Rabbits were irradiated with dose outputs of 24.5 R/min for total doses of 500, 900, 1200, and 1500 R. The results are graphed and show that the original rate of the water exchange process noticeably increases during irradiation with 500 and 900 R in comparison with the controls. An equilibrium was obtained in a much shorter time. Increase of the irradiation dose to 1200 and 1500 R does not lead to a further reduction of the time for attainment of equilibrium. (J.S.R.)

22340 WHOLE BODY X-IRRADIATION INFLUENCE ON PSEUDOURIDINE EXCRETION IN URINE IN ANIMALS. Fedorov, N. A.; Kosenko, A. S. (Central Inst. for Medical Graduate Work, Moscow. Moscow Academy of Veterinary). Radiobiologiya, 6: 534-7(1966). (In Russian).

The effect of whole-body x-irradiation at doses of 600 R on the urinary excretion of pseudouridine was studied in white rats. The results show a significant increase of the pseudouridine after whole-body irradiation with 600 R. The maximum increase of the excretion of pseudouridine from the organisms of the irradiated rat occurs in the first day after irradiation, and approaches normal on the fourth day after irradiation. It was concluded that the pseudouridine appears as a result of a disturbance of the metabolism of the pyrimidine nucleotides and of the destruction of cells. The increase of the concentration of pseudouridine acid can be explained by the supplementary injury to the cells during formation of RNA of other nucleotide composition. (J.S.R.)

22341 INFLUENCE OF HYPOPHYSIS ON THE FUNCTION OF ADRENAL GLAND CORTEX DURING RADIATION SYNDROME CAUSED BY RADIOACTIVE PHOSPHORUS INJECTION. Laiosh, Nad'; Ovakimov, V. G. (Inst. of Industrial Health and Occupational Diseases, Moscow). Radiobiologiya, 6: 538-43(1966). (In Russian).

The injection of ^{32}P in quantities of 3 mCi/g body weight of rats caused a subacute form of radiation sickness. Death of the animals was not observed during the 40 days of the test. The function of the adrenal cortex was increased which was shown by an increase in the weight of the cortex and the concentration of the corticosterone in the blood. Hypophysectomy performed before injection of ^{32}P significantly increased the radiosensitivity of the rats: the radiation sickness in these animals was acute. Injection of anterior pituitary extract caused in healthy animals some decrease in the weight of the hypophysis which possibly was connected with the compensatory decrease of the functional activity. In rats receiving ^{32}P, the injection of the extract intensified the pattern of the radiation sickness; the function of the adrenal cortex in these animals was increased in comparison with rats receiving only ^{32}P. This indicates an increased sensitivity of the cortex to the anterior pituitary extract. The injection of the extract in animals with a hypophysectomy but with no injection of ^{32}P caused some improvement of the general condition, inhibited a loss of weight, and showed no increase in lymphocytic and eosinophilic leukocytes. In hypophysectomized rats injected with ^{32}P, the injection of the extract somewhat improved the general condition of the animal although its life span was not lengthened. (tr-auth)

22342 STRONTIUM METABOLISM. Brit. Med. J., 2: 1215-16 (Nov. 19, 1966).

Research on strontium metabolism is reviewed. The three avenues of research that were considered were metabolism of strontium-90 in the human system, methods for removal of radiostrontium from the body, and uses of radiostrontium tracer techniques. (TSS)

22343 CHANGES IN ACTIVITY OF GLUTAMATE-ALANINE AND GLUTAMATE-ASPARAGINE AMINOPHERASES IN THE CENTRAL NERVOUS SYSTEM AND SKELETAL MUSCLE IN X-RAY IRRADIATION. Pikulev, A. T.; Polyakova, Z. I. (Belorussian State Univ., Minsk. Inst. of Physiology, Minsk). Vop. Med. Khim., 13: 25-8(Jan.-Feb. 1967). (In Russian).

In whole-body x-ray irradiation (40 R) of rats the changes of activity of glutamate-alanine and glutamate-asparagine aminopherases are different in cerebrum hemispheres, cerebellum, spinal cord, and skeletal muscle. The greatest changes of glutamate-alanine aminopherase have been found in cerebellum and glutamate-asparagine aminopherase in cerebrum hemispheres and cerebellum. In skeletal muscle changes of activity of glutamate-alanine aminopherase have been noted in 1 and 2 hours and in 1, 7 and 30 days after irradiation. Glutamate-asparagine aminopherase is the most sensitive to x rays. (auth)

22344 EFFECT OF DEHYDRATION AND REHYDRATION ON THE VASOPRESSOR ACTIVITY AND HISTOCHEMICAL PICTURE OF NEUROHYPOPHYSIS OF NORMAL AND IRRADIATED RATS. Bagramyan, E. R.; Babadzhanova, S. Yu. Probl.

Endokrinol. Gormonoterap., 12: No. 6, 94-9(Nov.-Dec. 1966). (In Russian).

Animal dehydration (drinking of 5% sodium chloride solution for a period of 4 days), both of intact and of irradiated ones, led to a marked reduction of vasopressor activity of neurohypophysis. A considerable reduction of the number of neurosecretory granules was observed histochemically. Water was given both animals for 24 hours after 4-day dehydration. This led to a distinct accumulation of vasopressor activity in the neurohypophysis, and histochemically—to increase of neurosecretory substance. These data indicated that in irradiated animals no change occurred in the ADH synthesis in the neurons of supraoptic and paraventricular nuclei of the hypothalamus and their transport into the neurohypophysis. A correlative association exists between the amount of the neurosecretory substance detected histochemically and the vasopressor activity of the neurohypophysis extract. (auth)

22345 DISTRIBUTION OF POTASSIUM (^{42}K) AND RUBIDIUM (^{86}Rb) IN DIFFERENT PARTS OF DENERVATED MUSCLE. Graban, Wieslaw (Warsaw Medical School). Invest. Radiol., 1: 445-8(Nov.-Dec. 1966).

Potassium (^{42}K) and rubidium (^{86}Rb) were used to investigate the metabolism of these cations in denervated muscle. The experiments were performed in 120 rats. The terminal and middle parts of the muscles were investigated separately and a contralateral muscle as a whole. In the early period after denervation (up to the third day) an increase of potassium and rubidium was found in the terminal part of the muscle while a decrease of the concentration of these electrolytes was found in the middle part. After the third day the concentrations of potassium and rubidium gradually decreased. When the muscle was investigated as a whole, the differences of concentration after denervation were not seen as clearly. The disturbances in electrolytes in denervation were not seen as clearly. The disturbances in electrolytes in denervated muscle are due to the dislocations of these elements in the muscle itself. (auth)

22346 ^{210}Po IN BRONCHIAL EPITHELIUM OF CIGARETTE SMOKERS. Little, John B. (Harvard School of Public Health, Boston); Radford, Edward P. Jr. Science, 155: 606-7(Feb. 3, 1967).

Detailed analyses of tissue specimens from respiratory passages of 25 cigarette smokers revealed that the average concentration of ^{210}Po in bronchial walls and submucosa was 0.004 pCi/g and 0.013 pCi/g in superficial mucus. In the bronchial epithelium located in the trachea, the average concentration of ^{210}Po was 0.12 pCi/g; in lobar bronchi, 0.19 pCi/g; and in segmental bifurcations, 4.5 pCi/g. It was pointed out that analysis of bronchial epithelium for ^{210}Po should be performed as soon as possible after death since postmortem changes in this tissue were observed to occur rapidly. In addition to ^{210}Po, tobacco smoke was found to contain ^{210}Pb; this may account for the presence of ^{210}Po in pulmonary tissues of nonsmokers as well as smokers. (B.H.S.)

22347 ON CHANGES OF CARBOHYDRATE METABOLISM INDICES IN DIAGNOSTIC APPLICATION OF RADIOACTIVE PHOSPHORUS. Leshchinskii, A. F.; Dubovyi, E. D.; Shvarts, G. Ya. (Pirogov Medical Inst., Odessa. Research Inst. of Curortology, Odessa). Vop. Onkol., 13: No. 2, 30-4(1967). (In Russian).

The influence of indicative doses of ^{32}P on carbohydrate metabolism was studied in 90 persons subjected to exploratory procedures for establishing the differential diagnosis between the benign and malignant neoplasms. It was found out that indicative doses of ^{32}P had a slight influence on unimpaired carbohydrate metabolism. (auth)

22348 ACCUMULATION OF RADIOACTIVE STRONTIUM BY THE BROWN SEA WEEDS. Zlobin, V. S. Gig. Sanit., No. 12, 86-8(Dec. 1966). (In Russian).

The metabolism of ^{89}Sr comes to equilibrium within 5 to 7 days in the brown seaweeds, Fucus vesculosis, Fucus serratus, and Ascophyllum nodosum. The ^{89}Sr half life is 6 to 8 hours and the half life curve approaches an exponential curve. An increase of stable Sr in sea water up to 0.16 g/liter causes a threefold reduction in ^{89}Sr uptake by the seaweed, Fucus serratus. (R.V.J.)

22349 INTRAVASCULAR ACTIVATION OF THE CLOTTING SYSTEM WITH PHOSPHOLIPIDS. PRODUCTION OF THE GENERALIZED SHWARTZMAN REACTION WITH PLATELET FACTOR 3. Rodriguez-Erdmann, F. (New England Medical Center Hospitals, Boston). Blood, 26: 541-53(Nov. 1965).

Morphologic and coagulative changes produced by infusing phospholipid having platelet factor 3 activity, or soya bean phospholipid (Inosithin), were studied in rabbits previously given intravenous Thorotrast (ThO_2) injections to block the reticuloendothelial system. The results indicated that infusion of either phospholipid in animals previously given Thorotrast resulted in anatomic and coagulopathic pictures closely resembling those seen in animals undergoing the generalized Shwartzman reaction elicited with endotoxin. Gram-negative endotoxin had no thromboplastic effect on purified prothrombin but a double effect on the clotting mechanism, i.e., one activating the contact active factors and the other resulting in release of platelet factor 3 activity. The Hageman factor may participate in the release of platelet factor 3, thus explaining the two apparently different points of action of endotoxin. This hypothesis is consistent with the fact that platelet factor 3 was not released from washed platelets incubated with endotoxin, while, on the other hand, the incubation of platelet-rich plasma with endotoxin resulted in the liberation of this factor. Platelets of animals undergoing the generalized Shwartzman reaction show reduced platelet factor 3 activity. Since a condition resembling this reaction can be produced in rabbits pretreated with Thorotrast by infusing phospholipids with high platelet factor 3 activity, the activation of the clotting system by endotoxin may be dependent upon the release of platelet factor 3 from the thrombocytes. Whether or not release of this factor occurs directly or through the activation of Hageman factor (factor XII) is not clear. (BBB)

22350 BIOPHYSIKALISCHE PROBLEME DER STRAHLENWIRKUNG. JAHRESTAGUNG DER DEUTSCHEN GESELLSCHAFT FUER BIOPHYSIK AM 23./24. APRIL 1965 IN HOMBURG/SAAR, TAGUNGSBERICHT. (Biophysical Problems of Radiation Effects. Annual Meeting of the German Society for Biophysics on April 23 and 24, 1965 in Homburg/Saar, Germany). Muth, H. Stuttgart, Georg Thieme Verlag, 1966. 198p. (CONF-650455).

An abstract has been prepared for each of the 26 papers included. (J.S.R.)

For abstracts of individual papers see: 21931, 21983, 22351–22362, 22380, 22422, 22423, 22530–22535, 22694, 22695, and 22834.

22351 RADIOBIOPHYSICS IN MEDICINE AND RESEARCH. Rajewsky, B. (Max-Planck-Institut fuer Biophysik, Frankfurt am Main). pp 1-9 of Biophysikalische Probleme der Strahlenwirkung. Muth, H. Stuttgart, Georg Thieme Verlag, 1966. (In German).

The use of radiation and radioisotopes in basic and applied medicine and research is outlined. The interrelationship of the various scientific disciplines is emphasized. (J.S.R.)

22352 GENERAL AND ORGAN SPECIFIC ^{137}Cs RETENTION IN RATS AFTER SINGLE i.p. INJECTION. Bretfeld, G.; Muth, H.; Oberhausen, E. (Univ., Saarlandes, Homburg, Ger.). pp 26-33 of Biophysikalische Probleme der Strahlenwirkung. Muth, H. Stuttgart, Georg Thieme Verlag, 1966. (In German).

After i.p. injection of ^{137}Cs in rats, the whole body retention, the muscle retention, the organ retention, and the ^{137}Cs/K ratio were determined. The ^{137}Cs concentration in the whole body decreased with a half life of 15 days. In the phase of the uniform ^{137}Cs elimination the muscles have always a higher ^{137}Cs concentration than the bones. Muscles and bones eliminate the ^{137}Cs equally rapidly. The difference of the ^{137}Cs concentrations between muscles and bones and between anatomically different muscles is caused by the difference in the K concentration of the tissues. In the first week after injection the ^{137}Cs is distributed to the various muscles with different kinetics. (tr-auth)

22353 NATURAL RADIATION EFFECT IN THE RESPIRATORY TRACT AFTER INHALATION OF SHORT-LIVED RADON AND THORON DECAY PRODUCTS. Jacobi, W. (Hahn-Meitner-Institut fuer Kernforschung, Berlin). pp 53-64 of Biophysikalische Probleme der Strahlenwirkung. Muth, H. Stuttgart, Georg Thieme Verlag, 1966. (In German).

The natural radiation effect on the individual areas of the respiratory tract to be expected from the inhalation of Rn and thoron decay products was evaluated. The separation of the Rn and thoron decay products in the various regions of the respiratory tract is outlined. Ciliary transport and elimination from the respiratory tract are considered. The stationary activity distribution is then discussed, and the dose distribution in the respiratory tract is evaluated. The results showed that the natural inhalation dose in the respiratory tract is caused essentially by the inhalation of short-lived Rn decay products because of the relatively low ThB concentration in the atmosphere. The mean dosage caused by the inhalation of Rn and thoron decay products is approximately 50 mrem/a in the alveolar tissue and approximately 80 mrem/a in the basal cells of the trachea. The maximum radiation charge is found in the area of the middle bronchi. The radiation burden of the basal cells in the trachea and bronchi is caused principally by the inhalation of RaB and RaC. (J.S.R.)

22354 RADIOBIOLOGICAL UTILIZATION OF THE ELECTRON SPIN RESONANCE METHOD. Redhardt, A. (Max-

Planck-Institut fuer Biophysik, Frankfurt am Main). pp 65-75 of Biophysikalische Probleme der Strahlenwirkung. Muth, H. Stuttgart, Georg Thieme Verlag, 1966. (In German).

A bibliographic review is made of the utilization of the electron spin resonance method in biological studies. Electron resonances in x- and γ-irradiated amino acids and peptides, electron spin resonance studies on irradiated intact systems, and radical fixation and migration of the radical state are considered. 43 references. (tr-auth)

22355 FREE RADICALS IN UV- AND X-IRRADIATED SULFUR-CONTAINING ORGANIC SUBSTANCES. Moenig, H.; Koch, R. (Univ., Freiburg i.B.). pp 77-83 of Biophysikalische Probleme der Strahlenwirkung. Muth, H. Stuttgart, Georg Thieme Verlag, 1966. (In German).

The radical behavior in the substances methionine, cattle serum albumin, and homocysteinethiolacton with respect to various types of irradiation was shown. The processes can be followed by a consideration of the radical concentration as a function of the uv irradiation time and by use of various uv wavelength regions. The radicals were measured with the electron spin resonance method. The uv irradiation of x-irradiated methionine causes an initial sharp decrease of the radical concentration with a subsequent increase. In uv irradiation of x-irradiated cattle serum albumin there is an immediate increase of the radical concentration. In the x-irradiation of homocysteinethiolacton at least two types of radicals appear. These radicals are stable in O_2. Subsequent irradiation with uv does not affect the radical concentration. (J.S.R.)

22356 THE INACTIVATION OF PEPSIN BY X RAYS AND ITS DEPENDENCE ON THE WATER CONTENT AND ITS RATIO IN THE ESR SPECTRA OF PEPSIN. Sommermeyer, K.; Schnepel, G. H. (Univ., Freiburg i.B.). pp 99-107 of Biophysikalische Probleme der Strahlenwirkung. Muth, H. Stuttgart, Georg Thieme Verlag, 1966. (In German).

Pepsin with various water concentrations up to 60% was irradiated with x rays and electrons and the dependence of the radical numbers and the inactivation rate on the storage time was measured. A contribution to the ESR spectrum increasing with the water content was quenched very probably immediately after the electron passage. Nevertheless the inactivation rate is completely independent of the water concentration. In storage of the dry enzyme in air for more than 18 days the inactivation rate remains completely constant whereas the ESR spectrum decays. The results are discussed. Independent therefore of whether the pepsin radicals contribute or not to the inactivation, it must be concluded that the reaction of H_2O with the radicals during the irradiation, after the irradiation, and in the solution of pepsin and water is the same. Therefore it is probable that the radicals do not contribute to the inactivation. (tr-auth)

22357 AMINO ACID ANALYSIS AS AUXILIARY IN THE DETECTION OF RADIATION EFFECTS ON PROTEINS. Siebert, W.; Dose, K. (Technische Hochschule, Hanover). pp 108-11 of Biophysikalische Probleme der Strahlenwirkung. Muth, H. Stuttgart, Georg Thieme Verlag, 1966. (In German).

As an example of the detection of the radiation effects on proteins by ion exchange chromatography, a protein of known molecular weight and defined primary structure (insulin) in solution was irradiated with various doses of uv at 2537 Å. The differences obtained in the amino acid spectrum of the insulin was determined with an amino acid analyzer and quantitatively evaluated. It was shown that in dependence on given structural units a significant effect can be detected. (tr-auth)

22358 THE FLUORESCENCE OF UV- AND X-IRRADIATED DNA SOLUTIONS. Keck, K.; Hagen, U. (Univ., Freiburg i.B.). pp 112-15 of Biophysikalische Probleme der Strahlenwirkung. Muth, H. Stuttgart, Georg Thieme Verlag, 1966. (In German).

The development of the fluorescence with the irradiation dose with uv and x radiation was shown graphically and compared with a solution containing 1 mg of quinine. To determine whether there is an O_2 effect the solutions were irradiated under N_2 and then gased with O_2 for an hour. Both extinction and fluorescence were unchanged. The four desoxynucleotides show following x irradiation in the presence of oxygen a variation of the fluorescence development. TMP and DGMP fluoresce the strongest. (J.S.R.)

22359 RADIATION SENSITIVITY OF DESOXYRIBONUCLEIC ACID IN THE CELL. Hagen, U. (Institut fuer Strahlenbiologie des Kernforschungszentrums, Karlsruhe, Ger.); Keck, K.; Kroeger, H.; Schuchmann, L. pp 116-19 of Biophysikalische Probleme der Strahlenwirkung. Muth, H. Stuttgart, Georg Thieme Verlag, 1966. (In German).

A study was made to determine, on the basis of simplifying criteria, the radiation damage to the DNA of irradiated cells. As criteria of the radiation damage the number of breaks in the nucleotide chain and the biological activity of the DNA as a starter in the enzymatic RNA synthesis were used. An analysis of the breaks in the DNA after irradiation in solution showed that the individual breaks increase with the dose. It was concluded that the variations in the DNA were not caused by secondary metabolism processes. Immediately after whole body irradiation no variation in the sedimentation could be observed. However it is to be emphasized that the biological activity of the DNA from irradiated animals does not vary from that of normal animals. (J.S.R.)

22360 POTASSIUM AND SODIUM TRANSPORT IN EHRLICH-ASCITES TUMOR CELLS AFTER X IRRADIATION. Hasl, G.; Pauly, H. (Univ., Erlangen, Ger.). pp 120-4 of Biophysikalische Probleme der Strahlenwirkung. Muth, H. Stuttgart, Georg Thieme Verlag, 1966. (In German).

The K and Na transport in Ehrlich-ascites tumor cells was studied after irradiation of densely packed cells at 4°C under anaerobic conditions. After 300 kr the uptake of K by the cells is only approximately half the concentration found in the controls. After 400 kr the final concentration is even lower. The studies showed that the K transport of the ascites tumor cells is very radioresistant and after even a dose of 300 kr the cell continues its K uptake. (J.S.R.)

22361 RADIATION EFFECT ON THE POTENTIAL AND RESISTANCE OF FROG SKIN. Trott, K.-R. (Univ., Munich). pp 125-9 of Biophysikalische Probleme der Strahlenwirkung. Muth, H. Stuttgart, Georg Thieme Verlag, 1966. (In German).

The electrophysiological changes in the isolated frog skin as a result of irradiation were studied. After irradiation of several minutes duration the membrane potential shows a typical pattern. There is first a latency period of four to six minutes and then an increase of the potential to a maximum followed by a decrease. The resistance pattern is similar but less sharp. Under conditions of anoxia, the resistance increases whereas the potential decreases. Studies of various ion permeabilities showed that the radio-induced changes of the electrical properties depend on variations of the Na permeability of the skin. (J.S.R.)

22362 ENZYME ACTIVITY OF GLYCOLYTIC FERMENTS AND THE ADENINE NUCLEOTIDE AND GLUTATHION CONTENT IN IRRADIATED BONE MARROW OF RATS. Loehr, E. (Univ., Muenster, Ger.). pp 130-7 of Biophysikalische Probleme der Strahlenwirkung. Muth, H. Stuttgart, Georg Thieme Verlag, 1966. (In German).

The adenine nucleotide concentration and the enzyme activity of glycolytic ferments in the bone marrow were investigated before and after whole body irradiation of rats at an x-ray dose of 780 R. The concentration in oxidized and reduced glutathion was then studied in order to establish a possible displacement of the redox potential under the effect of ionizing radiation. Immediately after whole body irradiation a reduced enzyme activity is detectable. Substrate concentrations in the peripheral blood and bone marrow of the rat were also determined. The results are shown graphically. Significant variations of the oxidized and the reduced glutathion content were found in the irradiated rats. The significance of these results is discussed. (J.S.R.)

22363 THE RELATIONSHIP OF CALCIUM AND STRONTIUM IN THE MINERALIZED TISSUES OF THE RAT: REPLACEMENT AND EXCHANGE OF THESE ELEMENTS IN VIVO AND IN VITRO. Johnson, Arthur Rinaldo. Minneapolis, Univ. of Minnesota, 1966. 189p.

Thesis.

The effects of strontium on growth, its removal by physiologic mechanisms, and its relation to the mineral phases of bones and teeth have been investigated. Five groups of weanling rats were provided these diets for 43 days: Diet I, 0.22% Ca, 0.45% Sr, 0.41% P, ^{89}Sr; Diet II, 0.22% Ca, 0.45% Sr, 0.41% P; Diet III, 0.20% Ca, trace Sr, 0.45% P, ^{89}Sr; Diet IV, 0.40% Ca, trace Sr, 0.42% P, ^{89}Sr and Diet V, 0.78% Ca, trace Sr, 0.57% and ^{89}Sr. The mandibles, vertebrae, humeral epiphyses and diaphyses, whole incisor and molar teeth and pooled incisor enamel and dentin were analyzed for their ash and strontium contents. The mandibular, enamel and dentinal ash were also analyzed for calcium, phosphorus, sodium and potassium. It was shown that the strontium content of the whole tissue must be determined to properly assess the physiological removal of strontium. The translocation of strontium occurred to the incisor teeth and was suggested to occur to the humeral epiphyses but not to the other tissues examined. Radioisotopic exchange equilibrium experiments with bone of low or high strontium content were performed for periods up to 8½ hours. Leaching experiments employing an alcoholic-hydrochloric acid medium were made with bone and dentin of low or high strontium contents. X-ray powder diffraction patterns of pulverized incisor enamel of low or high strontium content and an enamel spicule of high strontium content were made. The electron microprobe was used to make semiquantitative analyses for calcium, strontium and phosphorus in incisor teeth of low or high strontium

content. This study has shown that strontium affects fundamental metabolic processes necessary to maintenance and growth of the hard tissues and that strontium may produce alterations of the calcified tissues by forming a compound different from those considered to be normally present in the body. (Diss. Abstr.)

Ecology

Refer also to abstract 23793.

22364 (BNWL-235-2) ANNUAL REPORT FOR 1965 IN THE PHYSICAL SCIENCES. VOLUME 2. RADIOLOGICAL SCIENCES. Pearce, D. W.; Green, J. K. (eds.) (Battelle-Northwest, Richland, Wash. Pacific Northwest Lab.). May. 1966. Contract AT(45-1)-1830. 178p. Dep. mn. CFSTI $3.00 cy, $0.65 mn.

Progress is reported on the following studies in radiological physics: fast pulse averaging; time-resolved spectroscopy; specific ionization of monoenergetic protons in tissue-equivalent gas; grid-walled proportional counter; self absorption in scintillation crystals; pulsed x-ray machine; local energy density and hit theory; long term change of Pu-Be neutron sources; local-energy-density distributions; calorimetric measurement of ^{210}Po; apparatus for local-energy-density measurements; absorbed-dose-calorimetry; fast neutron medical research facility; tissue equivalent ion chamber development; calculation of the distribution of dose in linear energy transfer from spherical proportional counter data; low energy fast neutron spectrometer; transition zone dosimetry; whole body counting of plutonium in dogs; short-term retention of plutonium in dogs; plutonium whole body counting; ^{55}Fe in the marine environment and in people who consume ocean fish; seasonal cycle of ^{137}Cs in Alaskan natives at Anatuvuk pass; the application of simplified whole body counting in Alaska. Progress is reported on the following studies in radiation chemistry: determination of erythrocyte size distribution; radiation-induced hemolysis of erythrocytes; effect of chloride ion on the radiolysis of erioglaucine solutions; electron spin resonance detection instruments; ^{60}Co irradiator flow system for electron spin resonance; long-lived organic radicals formed in irradiated aqueous solutions; reaction kinetics of free radicals in aqueous solution; chemical protection of agarose jellies from radiation damage. Progress is reported on the following studies in radiological chemistry: alpha-emitters in the Columbia river; the reduction of reactor effluent water radionuclide concentrations by the addition of sodium silicate to process water; the effect of reduced alum addition on the removal of ^{75}As at the KW-Reactor water treatment plant; ion exchange studies of the chemical form of radionuclides in Columbia river water and reactor effluent; determination of seasonal variations in sediment deposition rates in McNary Reservoir of the Columbia River; the use of $^{65}Zn/^{60}Co$ ratios to determine age and deposition rate of river bottom sediments; a method for determination of ^{32}P and other radionuclides on filters containing suspended river sediments; behavior and transport of radionuclides in the Columbia River between Hanford and Vancouver, Washington; natural and artificial radionuclide concentration in farm produce irrigated with Columbia River water; distribution and excretion of technetium in humans; ^{210}Pb and ^{210}Po in Alaskan biological samples; the distribution of natural and artificial radionuclides through the food chain in Alaska; ultrasensitive measurement of radionuclides and trace element constituents in the ocean by multidimensional gamma-ray spectrometry; cosmic-ray produced radionuclides in the environment; trace element measurements in snow; concentration of fallout radionuclides during wet and dry seasons; airborne radionuclides measurement; ^{133}Xe as an atmospheric tracer; the measurement of ^{131}I transport in atmospheric diffusion experiments; organic ^{131}I compounds released from a nuclear fuel chemical processing plant; fission product aerosol behavior in the plutonium recycle test reactor fuel rod failure of September 29, 1965; a simplified method for the determination of trace elements in geologic samples by activation analysis; identification of individual basalt flows by activation analysis; trace element impurities in vitreous silica tubing; preliminary evaluation of an existing multidimensional gamma-ray spectrometer for whole body counting; an anticoincidence-shielded Ge(Li) gamma-ray spectrometer; redesign and application of an anticoincidence-shielded Ge(Li) gamma-ray spectrometer; evaluation of radiochemical methods for biological purposes; determination of elements in wheat grain by neutron activation analysis and multidimensional gamma-ray spectrometry; selective and sensitive analysis of activation products by multidimensional gamma-ray spectrometry; gamma-ray background studies for NaI(Tl) and plastic detectors; gamma-ray transitions in ^{59}Fe; trace elements in cancerous and non-cancerous human tissues. (H.L.W.)

22365 (BNWL-SA-993) DEPOSITION OF A WIDE SPECTRUM OF RADIONUCLIDES IN THE FOOD CHAIN BY NUCLEAR PRODUCTION AND TESTING OPERATIONS. Perkins, R. W.; Nielsen, J. M. (Battelle-Northwest, Richland, Wash. Pacific Northwest Lab.). Feb. 20, 1967. Contract AT(45-1)-1830. 18p. (CONF-670313-1). Dep. mn. CFSTI $3.00 cy, $0.65 mn.

From International Conference on Environmental Radiological Protection Connected with the Development of the Peaceful Uses of Nuclear Energy, Toulouse, France.

Multidimensional γ spectrometry was used for determining the absolute and relative behavior of complex radionuclide groups in several ecosystems. Sample preparation and instrumental methods of analysis are described. Radionuclide distributions and concentrations were measured in: the Alaskan food chain, Olympic National Park, Columbia River fish, farm produce irrigated with Columbia River water, and surface water and marine organisms in the Columbia River plume. Measurement of the natural accumulation of radioisotopes in tissues of Alaskan animals are the first for some of the radionuclides and show the movement through the food chain relative to the well established behavior of ^{137}Cs. Concentrations of radionuclides were determined in muscle tissue of elk and in the atmosphere at Olympic National Park. Cesium-137 and ^{22}Na concentrations in elk muscle were comparable to those in Alaskan caribou muscle. The relative concentrations of various airborne radionuclides, if corrected for decay, were similar in samples from Alaskan and Olympic forest samples. Studies of long-lived nuclides in Columbia River fish emphasized concentration processes in the food chain. Of the radioisotopes detected in produce and fodder from land irrigated by Columbia River water, only ^{46}Sc, ^{51}Cr, ^{60}Co, and ^{65}Zn appeared to originate chiefly in the irrigation water. Radionuclide concentrations in surface ocean water were compared with those present in a sample of euphausiids collected off the coast of Oregon. It is concluded that the euphausiids are analogous to the Alaskan lichen in providing a high radionuclide concentration early in the food chain. (H.G.D.)

22366 (CEA-R-3076) ETUDE DES POSSIBILITES D'UTILISATION DES RESULTATS DE LA SURVEILLANCE DE LA RADIOACTIVITE POUR LA RECHERCHE DES TRAJECTOIRES D'EVOLUTION DE LA CONTAMINATION DES VECTEURS ALIMENTAIRES. (Possibility of Using Radioactivity Control Measurements for Determining Contamination Paths in Nutritional Vectors). Garnier, Arlette (Commissariat a l'Energie Atomique, Fontenay-aux-Roses (France). Centre d'Etudes Nucleaires). Nov. 1966. 49p. (In French). (EUR-3001.f). Dep. mn.

Data are given on the possibility of using results of radioactivity controls for determining the paths followed by contamination in nutritional vectors; these are necessary for calculating protection norms. Radioactive contamination of a nutritional vector is expressed in terms of parameters which suggest that a certain number of criteria may be used for choosing the results which are to be exploited. An actual example of a "vertical" study based on results of measurements made purely for control purposes shows the difficulties which may be encountered. A list of the results obtained by the control networks set up in the Community Countries, either for the atmosphere, for milk, or for other foodstuffs, shows that these networks are not at the present organized in such a way as to make such a study possible. It appears desirable that a large part of the work carried out by the control Services be oriented in such a way as to yield the complementary information required for experimental studies of radioactive contamination transfers. (auth)

22367 (NP-16594) RECHERCHES PRELIMINAIRES SUR LA MIGRATION DU CESIUM 137 DANS LA CHAINE ALIMENTAIRE EAU-PLANTE-MOLLUSQUE-POISSON. (Preliminary Research on the Migration of ^{137}Cs in the Food Chain: Water-Plant-Mollusk-Fish). Note Bio-V/11. Wlodek, St. (Commissariat a l'Energie Atomique, Grenoble (France). Centre d'Etudes Nucleaires). Aug. 1965. 17p. (In French). Dep. mn.

Laboratory and in situ studies were made of the relation between the level of ^{137}Cs radioactivity in water, plants, mollusks, and fish. In the presence of very low quantities, the mollusks, Limnaea ovata, accumulate approximately 12 times as much as plants. In the presence of Cs quantities much larger than those resulting from fallout in an ecosystem the radioactivity level caused by ^{137}Cs in the mollusks increases comparatively slowly. The ratio between the contamination level of the plants and the contamination level of mollusks nourished by these plants is modified radically as the mollusks are contaminated only one-fifth as much as the plants. This leads to the hypothesis of the existence in the mollusk of a control mechanism for the consumption, elimination, and absorption of Cs. The accumulation of Cs in the mollusk is not proportional to the quantity of the element in the medium. The activity increase in the mollusk due to Cs is slow. Adult mollusks placed in a contaminated

medium for two months attain scarcely half the activity level of mollusks born and reaching their maturity in the medium. The activity level of mollusks in the presence of a massive decomposition of plants contaminated and previously dried indicated that under the conditions of a cataclysm in the reservoir the Cs uptake by the mollusk can be doubled. In addition to the contamination by the alimentary path the mollusks are also contaminated directly by the water. The reduction of the activity level of the mollusks after introduction to noncontaminated water is intense. The contaminated mollusks recover their initial activity level after approximately a month. Preliminary studies on the contamination of fish, Tinca tinca, by alimentary canal show that during the first week after contamination the increase in radioactivity is intense. There is then a period of Cs saturation. There is a sharp decrease in the quantity of Cs in fish during the third week; the cause of this drop is not clear. (tr-auth)

22368 (SAN-310P4-3) PATHWAYS OF TRACE ELEMENTS IN ARCTIC LAKE ECOSYSTEMS. Progress Report, April 15, 1966–April 14, 1967. Barsdate, Robert J. (Alaska Univ., College. Inst. of Marine Science). Feb. 20, 1967. Contract AT-(04-3)-310. 61p. Dep. mn. CFSTI $3.00 cy, $0.65 mn.

The role of dissolved organic substances as mediators in the cycles of metals in lakes was assessed. Studies include the measurement of dissolved organic carbon and color in lake waters, the relationship between organic carbon content and water color, the distribution of particulate material and iron as a function of particle size, the precipitation of alkaline earth humate-iron colloids, and the influence of precipitation phenomena on trace metals in solution. (auth)

22369 INTENSITY OF THE ABSORPTION OF ^{32}P BY PINES AND SOME ASPECTS OF OTHER SOIL COVERING PLANTS. Yakushev, B. I. (Inst. of Experimental Botany, Minsk). Dokl. Akad. Nauk BSSR, 10: 698-700(Sept. 1966). (In Russian).

Leafy vegetables surpass pines with respect to the rate of absorption of phosphate more than 100 times and also reduces the energy for the uptake of ^{32}P in this wood species by 6.5 times. Heather absorbs phosphate only 2 to 6 times the rate of pines and appears in comparison with grasses a less dangerous competitor for pine planting for P_2O_5. Grassy plants with respect to the rate of exchange of the phosphate ions with the surrounding medium surpass pines by more than 100 times. This explains the high exactions of grassy plants on soil fertility. (tr-auth)

22370 ALTERNATIVE WAYS OF EXPRESSING THE CONCENTRATION FACTORS FOR RADIOACTIVE SUBSTANCES IN AQUATIC ORGANISMS. Hela, Ilmo (International Lab. of Marine Radioactivity, Monaco). Bull. Inst. Oceanogr., 61: No. 1280, 1-8(Dec. 1963).

A list of the mathematical formulae in which the concentration of radioactive substances in aquatic organisms may be expressed is given. The factors given were the chemical concentration factor, the concentration factor of a radioisotope, the experimental concentration percentage, and the ratio of the accumulated radioactivity to the background radioactivity. The chemical concentration factor and the concentration factor of a radioisotope (of the same element) were considered identical; the experimental concentration percentage and the ratio of the accumulated radioactivity to the background radioactivity were not. All expression factors considered were based upon the concept of specific activity (B.H.S.)

22371 THE RECOLONIZATION OF GAMMA-IRRADIATED SOIL BY SMALL ARTHROPODS: A PRELIMINARY STUDY. Coleman, David C. (Savannah River Ecology Lab., Aiken, S. C.); Macfadyen, Amyan. Oikos, 17: 62-70(1966).

The reinvasion of radiosterilized soil by micro-organisms was studied, as well as the effect of irradiation on some nutrients in the soil. Cores of litter and soil were placed in polythene bags and irradiated in a ^{60}Co γ source at either 2.5 or 5.0 Mrad. A few cores were irradiated at 5 Mrad with spent fuel. Analyses of exchangeable ammonium and nitrate were compared for newly irradiated samples, samples which had been in the field for 8 weeks after irradiation and inoculation, and unirradiated fresh samples. Several-fold increases in ammonium and nitrate in irradiated cores persisted, with little change, throughout the course of the experiment. The numbers of microarthropods recolonizing irradiated cores were assessed two months after return of the cores to the field. Soil microarthropods recolonized irradiated, inoculated samples in some cases in patterns varying with different species of fungi. Respiration of cores after irradiation was at first lower than, and subsequently higher than, that of unirradiated control cores for a month afterward. The methods described are offered as tools for possible use in more detailed studies of the litter-soil ecosystem. (BBB)

22372 UPTAKE OF U AND Pu BY SEAWEEDS. Zlobin, V. S. Radiobiologiya, 6: 613-7(1966). (In Russian).

The northern seaweed Chorda filum, Monostina fuscum, and Laminarisa saccharina are capable to different degrees of accumulating in their tissues ^{239}Pu and natural mixtures of U. The size of the uptake accumulation is sharply dependent both on the individual characteristics of the seaweed and on the physical-chemical state of the ^{239}Pu and U in the sea water. The total α radioactivity of some forms of northern seaweed was determined principally by the U contained in their tissues. (tr-auth).

Genetics and Cytogenetics

Refer also to abstracts 22783, 22795, and 22835.

22373 (ACRH-26, pp 1-15) CHROMOSOME STUDIES IN PRE-LEUKEMIA. I. ANEUPLOIDY OF GROUP C CHROMOSOMES IN THREE PATIENTS. Rowley, J. D.; Blaisdell, R. K.; Jacobson, L. O. (Argonne Cancer Research Hospital, Chicago, Ill.).

Results are reported for chromosome studies on three patients with apparently unrelated hematologic syndromes who had marrow chromosomal abnormalities involving the C group, similar to those observed in cases of leukemia. All three patients showed persistent chromosomal aberrations in some or all metaphases of cultured bone marrow and all had essentially normal karyotypes in metaphases from peripheral blood. These cases emphasize the need for including a study of the bone marrow, as well as of the blood, in any comprehensive cytogenetic examination of hematologic disorders. (C.H.)

22374 (ACRH-26, pp 23-32) CHARACTERISTICS OF THE HEREDITARY ANEMIA OF Sl^m MUTANT MICE. Kales, A. N.; Fried, W.; Gurney, C. W. (Argonne Cancer Research Hospital, Chicago, Ill.).

Sl^m is one of a series of Sl-alleles of mice producing, in the homozygous condition, a macrocytic anemia associated with coat color change and sterility. The characteristics of this anemia are described. (C.H.)

22375 (ORNL-TM-1731) MUTAGENIC EFFECTIVENESS OF KNOWN DOSES OF GAMMA RADIATION IN COMBINATION WITH WEIGHTLESSNESS ON HABROBRACON. Summary Progress Report, February 17, 1964–June 30, 1966. von Borstel, R. C. (Oak Ridge National Lab., Tenn.). Mar. 1967. Contract W-7405-eng-26. 26p. Dep. mn. CFSTI $3.00 cy, $0.65 mn.

Progress is reported on the following studies: preparation of the Habrobracon stocks for the biosatellite experiment; biosatellite preparatory experiments; spontaneous mutation frequencies in Habrobracon; Habrobracon experiments in simulated space-flight tests; x radiation sensitivity of Habrobracon oocytes at diakinesis; time of death of a translocation segregant in Habrobracon; and x-ray induction of mutations in Habrobracon. (H.L.W.)

22376 (ORNL-TM-1732) [MUTAGENIC EFFECTIVENESS OF KNOWN DOSES OF GAMMA RADIATION IN COMBINATION WITH WEIGHTLESSNESS ON HABROBRACON]. Quarterly Progress Report to the National Aeronautics and Space Administration, July 1–September 30, 1966. von Borstel, R. C. (Oak Ridge National Lab., Tenn.). Mar. 1967. Contract W-7405-eng-26. 42p. Dep. mn. CFSTI $3.00 cy, $0.65 mn.

Progress is reported on the following studies; mutations in Habrobracon; computer tabulation and analysis of data; measuring fecundity, fertility, and life span of Habrobracon females; simulated space flight test at Ames Research Center, June 17–20, 1966; radiation conditions in the Habrobracon biocompatibility tests at Ames Research Center, June 17–20, 1966; biocompatibility tests in flight vehicles; sex allele stocks in Habrobracon; survival of Habrobracon larvae under different degrees of crowding; chromosome breakage and dominant lethality. (H.L.W.)

22377 (STI-PUB-130) GENETICAL ASPECTS OF RADIOSENSITIVITY: MECHANISMS OF REPAIR. Panel Proceedings Series. Proceedings of a Panel held in Vienna, 18–22 April 1966. (International Atomic Energy Agency, Vienna (Austria)). Oct. 1966. 184p. (CONF-660418). IAEA: $4.00; S 104,-; £ 1.8.3; F Fr 19,60; DM 16,-.

Fourteen papers are included; separate abstracts have been prepared for twelve. Abstracts of two papers appeared previously in NSA as numbers 20: 40609 and 21: 9027. (M.M.B.)

For abstracts of individual papers see: 22389–22400.

22378 BACTERIAL AND VIRAL MUTATIONS: THEIR CONSEQUENCES IN INDUSTRIAL PRODUCTION. Prunet, R. P. (Laboratoire R. Bellon, Villaines-les-Rochers, France). Farm. (Pavia) Ed. Prat., 20: 506-16(Oct. 1965). (In French).

The use of uv and ionizing radiations and alkylating agents in inducing mutants in microorganisms of importance industrially is reviewed. Mutants of interest in industrial fermentation processes and in antibiotic production on a large scale are considered in particular. Virus mutations which can be used for vaccine production are also important. Problems in the selection of mutants after irradiation of cultures are considered with reference to developing poliovirus mutants of low virulence. Usual selection methods tend to select the most virulent strains so that these need to be modified as to provide optimal culture conditions for less virulent strains. Homogeneity of the vaccine strain is essential so that repeated animal passage of the mutant is required. (BBB)

22379 RADIOPHOSPHORUS-INDUCED SINGLE-CHAIN INTERRUPTIONS IN DNA. Rhoades, Marc; Thomas C. A. Jr. (Johns Hopkins Univ., Baltimore). J. Mol. Biol., 18: 288-91 (1966).

It was shown that the alkaline-sucrose sedimentation gradient profiles of phage DNA deteriorated markedly when phages were grown at increasing levels of ^{32}P. Certain limits and precautions were observed which gave sharp zones indicative of unbroken molecules. Three parallel preparations of T2 phage were grown in Escherichia coli B in a medium containing a constant amount of phosphorus (20 μg/ml) with increasing amounts of ^{32}P (0.10, 1.0, and 10 μCi/ml). The ultrasedimentation profiles showed that there was a correlation between the breadth of the zone and the amount of ^{32}P in the growth medium. This effect was not observed with undenatured molecules sedimenting through neutral sucrose gradients. To explore the highest practical level of radiolabeling, 3 preparations of P22 phage were prepared at considerably higher specific activities. The amount of ^{32}P was increased 10-fold and the total phosphate reduced by 5- to 10-fold. Salmonella typhimurium LT2 was grown to 10^8 cells/ml, ^{32}P was added, and the cells were infected with 1.5 P22 (wild type) phage per cell. The 3 sedimentation profiles showed a single zone, each centered about the same fraction, with increasing amounts trailing material in the preparations grown at higher radioactivities. There was an average of 7 ^{32}P atoms per chain in the preparation grown at 45 μCi/μg P. Approximately 14% of the chains suffered a decay of incorporated ^{32}P in 10 hr. This direct effect could account for a sizable fraction of the trailing material. It was likely that there were other effects of ^{32}P decay, as suggested by the smaller yet significant amounts of trailing material in these profiles. These 2 experiments indicated that radiophosphorus-induced single-chain interruptions could be minimized by reducing the level of radioactivity or by shortening the time of exposure. (BBB)

22380 INVESTIGATIONS ON THE MUTAGENIC EFFECT OF NITROSO COMPOUNDS. Trams, A.; Kuenkel, H. A.; Henke, H. (Univ., Hamburg). pp 156-62 of Biophysikalische Probleme der Strahlenwirkung. Muth, H. Stuttgart, Georg Thieme Verlag, 1966. (In German).

The mutagenic effect of N-nitroso-N-methyl-urethane, N-nitroso-morpholine, N-N-dinitroso-piperazine, N-nitroso-piperidine, and N-nitroso-N-methyl-acetamide was studied on Escherichia coli and Drosophila melanogaster and the results were compared with the mutagenic effects of x-radiation. The differences in the mutagenic effects of the urethane and acetamide were discussed at some length. (J.S.R.)

22381 STUDY OF NEWT MITOTIC CHROMOSOMES BY NEGATIVE STAINING. Barnicot, N. A. (London Univ.). J. Cell Biol., 32: 585-603(Mar. 1967).

A method is described for bursting single, selected mitotic cells on a fluid surface. Cells from cultures of newt heart tissue were burst on dilute solutions containing potassium and sodium with and without added calcium and also on dilute calcium chloride solution. The material was negatively stained with uranyl acetate or sometimes with ammonium molybdate or sodium phosphotungstate. The bodies of chromatids spread on NaCl/KCl solutions showed many parallel fibers about 150 Å in dia. Loops with a complex nodular structure were observed projecting from the sides and ends of chromatids. In calcium-containing solutions there was evidence of fiber coagulation; the chromatid body was more compact and laterally projecting fibers tended to be pulled out straight. Especially in the absence of calcium the chromosomal fibers had a nodular form and appeared to be composed of irregularly folded fibrillar elements. The question as to whether chromosomal fibers, which range in dia from about 50 to 300 Å, consist of single, folded threads or of two or more adjacent subunits is discussed. (auth)

22382 RELATIONSHIP BETWEEN ISOANTIGENICITY AND TRANSPLANTATION BEHAVIOR OF TUMOR HOMOGRAFTS. Moeller, Erna (Karolinska Institutet Medical School, Stockholm). Bibl. Haematol., 23: 167-71(1965).

The mechanism by which strictly strain-specific neoplastic cells acquire the ability to transgress histocompatibility barriers of the H-2 type was studied. It was found that nonspecific growth characteristics could be imposed on sp tumor cells by passaging them through newborn immunologically immature allogeneic hosts, through adult lethally x-irradiated foreign recipients, or through allogeneic hosts treated with isoantibodies directed against the tumor cells. The altered transplantation behavior of the cells was acquired in a stepwise fashion, as revealed by the gradual extension of the host range. The acquisition of complete nonspecificity, making growth possible in all H-2 incompatible recipients, required 3 passages in the foreign environment. Some properties of the strain-specific neoplasms and their nonspecific sublines were investigated. Differences in growth rate were not responsible for nonspecificity. The relevant variable appeared to be the concentration of H-2 isoantigenic receptors: the nonspecific tumors were characterized by a lower concentration than the specific lines. The stepwise increase in the capacity to transgress histocompatibility barriers was paralleled by a stepwise decrease in the concentration of antigens. Thus nonspecific tumors may arise by immunoselection of variants distinguished by their low antigen concentration. (BBB)

22383 INFLUENCE OF NONLETHAL DOSES OF RADIATION ON ALLELIC RECOMBINATION IN CHLAMYDOMONAS REINHARDI. Lawrence, C. W. (Wantage Research Lab., Eng.). Genet. Res., 9: 123-7(Feb. 1967).

The influence on allelic recombination of non-lethal doses of gamma radiation delivered at different stages during meiosis has been determined and the data compared with previous results concerning gene recombination. Both kinds of recombination are influenced at only two, probably the same two, meiotic stages. During the first sensitive stage, probably in preleptotene, the frequency of allelic recombination is increased, but that of gene recombination decreased. The frequency of both is increased during the second sensitive stage, which is probably in pachytene. (auth)

22384 THE LIMITS TO ARTIFICIAL SELECTION FOR BODY WEIGHT IN THE MOUSE. IV. SOURCES OF NEW GENETIC VARIANCE: IRRADIATION AND OUTCROSSING. Roberts, R. C. (Inst. of Animal Genetics, Edinburgh). Genet. Res., 9: 87-98 (Feb. 1967).

Two methods are examined of introducing new genetic variance into a line of mice selected for high 6-week weight which, at its limit, displayed no additive genetic variance. The first method—x-irradiation—gave largely negative results. Any further gain under selection that was achieved could not be clearly distinguished from a possible environmental trend. The second method—outcrossing to an unselected strain and then selecting from the cross—resulted in a clear gain over the original limit, but nine generations were required even to recover the original limit. Various methods of transcending selection limits are evaluated in terms of their application to livestock improvement. (auth)

22385 POISSON ANALYSIS ON THE DISTRIBUTION OF X-RAY-INDUCED CROSSOVERS IN SPERMATOCYTES OF DROSOPHILA. Zimmering, S.; Johnsen, R. C.; Fowler, G. (Brown Univ., Providence). Can. J. Genet. Cytol., 8: 216-19 (June 1966).

Drosophila males of the autosomal composition dp cn bw/+++ were x irradiated 1 to 2 hr after the onset of the prepupal stage with 1000 R and upon eclosion brooded each day for 5 days with 3 dp cn bw females. For each brood, crossover data for the dp-cn region were analyzed to determine their fit to the Poisson distribution. There was no good evidence of a significant deviation from this distribution in broods 1 to 4 representing the recovery of late and early spermatocytes, and possibly late spermatogonia (in broods 3 and 4). Brood 5 was characterized by a steep rise in population size and a marked deviation from Poisson distribution indicating the recovery of earlier spermatogonia. Failure to find a significant deviation in spermatocytes suggested that 1 crossover of the complementary pair was not recovered, that is, each recovered crossover arose from an independent event. The data appear to satisfy the prediction from the Peacock-Erickson model postulating the existence of a functional and a nonfunctional pole at meiosis I, but alternative possibilities are discussed. (BBB)

22386 CROSSING AND MUTATION GENETIC STUDIES ON THE CLEAR-PLAQUE MUTANTS OF SERRATIA KAPPA PHAGE. Steiger, H. (Johann-Wolfgang-Goethe-Univ., Frankfurt am Main). Z. Vererbungsl. 98: 111-26(1966). (In German).

Three agents (uv radiation, nitrous acid, and hydroxylamine) were used to induce some clear-plaque mutations (c and l) and other plaque mutations (b,e) of Serratia marcescens phage kappa (κ), which were mapped by crossing. Results are discussed and the mutation experiments are interpreted in connection with the

chemical mode of action of uv radiation and the 2 chemical mutagens. (TS8)

22387 MUTAGENIC AND CHROMOSOMAL EFFECTS OF X-RAYS AND ALKYLATING CHEMICALS ON TRITICUM DURUM DESF. 'LAKOTA'. Edwards, L. H. (Univ. of Oklahoma, Stillwater); Williams, N. D. Crop Sci., 6: 271-2(May-June 1966).

Seeds of Lakota durum wheat were treated with x rays, ethyleneimine (EI), diethyl sulfate (DS), and ethylmethanesulfonate (EMS). Chemical treatments that reduced germination and seedling height to approximately the same degree as 15.0- and 22.5-kR doses of irradiation were selected. Each chemical mutagen produced chromosomal aberrations in less than 3.0% of the M_1 spikes examined, whereas x rays produced aberrations in 7.6 to 77.2% of the M_1 spikes as the x-ray dose increased from 7.5 to 30.0 kR. Treatments with 0.5% EMS and 0.02% DS induced chlorophyll-deficient mutations in 23.33 and 6.94% of the M_1 spikes, respectively. The highest mutation rates induced by EI and x rays were 2.64 and 3.82% mutated M_1 spikes, respectively. Most of the segregations from the x rays, DS, and EMS treatments fit a theoretical 3:1 normal:mutant ratio. A lower percentage (47.4%) of the segregations from the EI treatments satisfactorily fit a 3:1 ratio. Much of the sterility observed in the x-ray-treated material was associated with chromosomal aberrations; however, the high frequency of sterility present after EMS treatment was apparently not due to chromosomal aberrations. This sterility may have been due to small intrachromosomal changes or to physiological disturbances induced by the chemical mutagen. (BBB)

22388 THE MUTAGENIC EFFECTS OF GAMMA RAYS ON ZEA MAYS IN RELATION TO EAR LOCATION. Sarvella, Patricia; Grogan, C. O. (Mississippi State Univ., State College. Dept. of Agriculture, Tifton, Ga.). Radiat. Bot., 7: 107-11(Apr. 1967).

The effects of γ-radiation on maize seeds were examined in a highly prolific line in relation to ear location and dose. Exposures were 0, 5000, 10,000, and 15,000 R. Mutation rates were related to ear position and the dose. The rates differed significantly from one side of the plant to the other. The top ear in the control, the 5000 and the 10,000 R treatments, had the highest mutation rates. The reverse was observed for the 15,000 R exposure. This decrease was probably related to a decrease in the number of seeds, which may not have permitted as many mutants to be recovered. (auth)

22389 REPAIR AT CHROMOSOME EXCHANGE SITES IN TRADESCANTIA PALUDOSA MICROSPORES. Savage, J. R. K. (Medical Research Council, Harwell, Eng.). pp 11-22 of STI-PUB-130.

An x-ray dose-response curve for chromosome exchanges has been obtained at the time when interaction with lesions produced by a priming dose of 300 rad was known to be minimal. A comparison of the parameters of this curve with those of a single-exposure dose-response curve obtained at the same time indicated that there is a marked reduction in the number of effective chromosome exchange sites available to a second dose. Consequently, the observed yield of exchanges at this time is less than that expected on the basis of simple additivity of the yields of the two doses given independently (the "base line"). On the assumption that the original unirradiated population had a limited number of sites for chromosome exchange, the data were consistent with the hypothesis of the repair of partially damaged chromosome exchange sites to pre-irradiation sensitivity of sites with only one potential exchange lesion. However, the possibility of dose-dependent inactivation of sites cannot be entirely excluded, and if a significant amount of this is occurring, then it is possible to interpret the fall in exchange yield with fractionated doses and the apparent loss of interaction between lesions without invoking repair. (auth)

22390 AN ADMONITION ON CHROMOSOME ABERRATION INDUCTION, AND THE QUESTION OF REPAIR. Revell, S. H. (Chester Beatty Research Inst., London). pp 25-8 of STI-PUB-130.

Chromatid breaks induced in root meristem cells of Vicia faba increase proportionally with x-ray dose to the power 1.7 and are relatively rare [Mut. Res. 3 (1966) 34-53]. These observations do not favor the theory that chromatid breaks occur as the primary event in exchange induction. If breakage is hit, the first event of exchange development, then repair of chromosome damage need not be equated with chromatid restitution. Hence, dose fractionation experiments would have a different interpretation from that generally placed upon them. (auth)

22391 REPAIR AND RECOVERY FROM CHROMOSOME DAMAGE AFTER FRACTIONATED X-RAY DOSAGE. Evans, H. J. (Univ. of Aberdeen, Eng.). pp 31-47 of STI-PUB-130.

In seven experiments Vicia faba root-tip cells and human peripheral blood leukocytes were exposed to single doses of x rays and to the same total doses split into two equal fractions separated by various time intervals up to 24 hr. In all the experiments, it was found that the yield of dicentric and ring aberrations decreased with increasing fractionation interval when short rest intervals were used, but when the time between two dose fractions approached 6 hr the aberration yield increased and equalled the yield obtained with a full unsplit dose and then fell once more. These results cannot be explained on the simple breakage-rejoining hypothesis. An hypothesis is presented which accounts for the results on the basis that radiation does not produce a direct breakage of chromosomes but induces lesions that are initially unstable. These lesions become stabilized and, some hours after their initiation, undergo repair. The repair envisaged may be analogous to that found in certain microorganisms exposed to ultraviolet light or alkylating agents and may involve the excision of the damaged zones and the resynthesis and polymerization of new chromosome materials. Chromosome aberrations are therefore suggested to be a consequence of mis-repair (cross-polymerization) involving two lesions; in the absence of repair no true exchange aberrations can be formed, the lesions simply remaining as stabilized lesions. It is suggested that regions that have not undergone repair in interphase appear at mitosis as non-staining gaps in the chromatids. Evidence is presented that single or paired gaps, showing linear and dose-squared kinetics, are reparable lesions and that the majority of gaps are repaired as a consequence of DNA synthesis. (auth)

22392 REPAIR REPLICATION IN THE BACTERIAL GENOME. Hanawalt, P. C. (Stanford Univ., Palo Alto, Calif.). pp 97-103 of STI-PUB-130.

Repair replication of DNA in bacteria can be demonstrated by the use of density labeling techniques and density distribution analysis of isolated DNA fragments in cesium chloride density gradients. This approach has been used to provide direct physical evidence for repair of damaged DNA after treatment of bacteria with ultraviolet light, nitrogen mustard, or nitrosoguanidine. Repair replication is not under the same control which limits normal replication to one round in the absence of protein synthesis and it can, in fact, occur under conditions of protein synthesis inhibition. Our demonstration of the repair mode of replication in normally replicating DNA and after thymine deprivation has led to the suggestion that the repair mechanism may have a necessary function in the normal replication and transcription of the bacterial chromosome. It is predicted that the non-conservative repair mode of DNA replication will be found in most living cells of the complexity of bacteria or of higher complexity; that this mechanism will have a necessary function in the normal growth process; and that it may also function in the repair of a variety of defects in DNA. (auth)

22393 REPAIR OF GENETIC RADIATION DAMAGE: A POSSIBLE CAUSE OF DIFFERENTIAL RADIOSENSITIVITY IN DROSOPHILA MELANOGASTER. Traut, H. (Univ., Muenster). pp 67-78 of STI-PUB-130.

The extent to which differential radiosensitivity in gametogenesis of Drosophila melanogaster can be explained by metabolic repair of premutational damage (including the rejoining of radiation-induced chromosome breaks) is discussed. Three stages of gametogenesis are considered, in which repair might occur: late spermatids ("immature sperm"); the gonial stage (both of spermatogenesis and oogenesis); and prophase I-oocytes. Experimental proof is given that there is no repair by storing of mature sperm. An hypothesis is proposed to explain the striking differences observed for the dosage-effect-relations for dominant lethal induction in metaphase I ("stage 14") and prophase I ("stage 7") oocytes, respectively. This hypothesis is partly based on differential repair (restitution) of chromatid breaks in these two oocytic stages. The implications of the low radiosensitivity of gonia and early oocytes for radiation damage to human germ cells are briefly considered. (auth)

22394 RADIATION DAMAGE TO DNA SEQUENCES AND REVERSION PROCESSES (A BIBLIOGRAPHY). Errera, M. (Univ. Libre, Brussels). pp 79-81 of STI-PUB-130.

Processes of mutation reversion and suppression have been discussed on the basis of what is known on amino acid sequences of specific proteins. Reversion can apparently take place in the cistron containing the information for the protein chain concerned: either in the mutated base pair, in a base pair of the mutated codon, or in another codon of the cistron. If the protein concerned is an oligomer, interallelic complementation suggests that the reversion can take place in a cistron coding for another fertile chain of the oligomer. The case of nonsense mutations (amber, ochre) was considered, with the probable mechanism of their suppression by mutations elsewhere in the genome, at places concerned with

the mechanism of translation of the mutated messenger RNA. (34 references). (auth)

22395 GENETIC RECOMBINATION AND REPAIR. Wilkins, B. M. (London Univ.). pp 85-7 of STI-PUB-130.

Two approaches to the problem of identifying the stages involved in the process of genetic recombination are considered. One has involved the construction of models to accommodate the data of fungal genetic analysis. It has been suggested in these models that the cross-over region includes heteroduplex or hybrid DNA and that its formation may necessitate mispairing of bases which may be corrected by repair enzymes. A second approach has involved the study of mutants which are defective in recombination. These display increased sensitivity to radiation and suggest a correlation between the enzymic mechanisms of repair and genetic recombination. (auth)

22396 PROCESSES UNDERLYING REPAIR AND RADIOSENSITIVITY IN SPERMATOZOA AND SPERMATIDS OF DROSOPHILA. Sobels, F. H. (Univ. of Leiden, Netherlands). pp 49-64 of STI-PUB-130.

Experimental evidence suggests that in both types of cells, the post-radiation effects arise from enzymatic repair of potential lesions leading to mutation or chromosome breaks. For sperm it could be demonstrated that neither post-radiation interaction of radicals with O_2 nor selective elimination of cells with genetic damage by post-treatment with N_2 can explain the observed effects. Radiosensitization after pre-treatment with sodium fluoride, iodoacetamide, ribonuclease or actinomycin-D suggests that in sperm both glycolytic enzymes and RNA or protein synthesis are involved in the repair process. In the early spermatids, on the other hand, oxygen is clearly required for repair to occur, and inhibition of RNA and/or protein synthesis by pre-treatment with actinomycin-D, ribonuclease, or chloramphenicol leads to a reduction of the radiation-induced mutation frequency. Studies on the origin of stage-specific differences in radiosensitivity showed that early spermatids are characterized by a considerably higher oxygen enhancement ratio than spermatozoa. Their greater response to radiation as compared with sperm thus arises from a greater intrinsic sensitivity to the induction of radiation damage in the presence of O_2. Oxygen enhancement ratios for fully mature spermatozoa and late spermatids, however, do not differ significantly, but the higher radiosensitivity in the former than in the latter cells appears to originate from a greater degree of oxygenation, under normal conditions in air. (auth)

22397 GENETIC AND ENZYMIC CONTROL OF RADIATION SENSITIVITY IN ESCHERICHIA COLI. Roersch, A. (National Defence Research Organization TNO, Rijswijk, Netherlands); van de Putte, P.; Mattern, I. E.; Zwenk, H.; van Sluis, C. A. pp 105-28 of STI-PUB-130.

A survey of various radiation-sensitive mutants is presented. According to their phenotypes, five different classes are distinguished: mutants in which the ability to divide after x- or uv-irradiation is reduced; uv-sensitive mutants which have lost the ability to repair uv lesions in bacteriophage DNA; uv-sensitive mutants which have not lost the ability to repair uv-lesions in bacteriophage DNA; uv-sensitive mutants which are in addition x-ray sensitive; uv-sensitive mutants which are x-ray sensitive and in addition defective in genetic recombination. Attention is focussed on the various linkage groups on the bacterial chromosome that have been recognized and to which each of the mutations involved belongs. A cell-free system for the demonstration of repair of uv-irradiated DNA in vitro is described. (auth)

22398 POTENTIALLY REVERSIBLE PHOTOCHEMICAL TRANSFORMATIONS IN NUCLEIC ACIDS IN RELATION TO REPAIR OF RADIATION DAMAGE. Shugar, D.; Fikus, M.; Tramer, Z.; Wierzchowski, K. L. (Inst. of Biochemistry and Biophysics, Warsaw). pp 131-41 of STI-PUB-130.

The elucidation of mechanisms of repair of radiation damage requires a knowledge of the nature of the radiation-induced chemical and structural modifications in nucleic acids. These problems are briefly outlined. An outline is presented of work carried out on the following problems: the mechanism of the alkaline transformation of photohydrated uracil glycosides and its application to the quantitative regeneration of uracil glycosides from their photohydrates; the reversible photochemical hydration of fluorouracil and its glycosides, as well as poly-FU, and the applications of incorporated fluorouracil to the study of repair mechanisms; the influence of secondary structure on thymine dimerization and its reversibility in the helix and coil forms of poly-rT and its twin-stranded complex with poly-A; the use of commercially available medium- and high-pressure mercury lamps in conjunction with simple filter systems in photobiological studies. (auth)

22399 DECREASING EFFECT OF DEOXYRIBONUCLEIC ACID ON THE BACK-MUTATION FREQUENCY IN X-IRRADIATED ESCHERICHIA COLI POPULATIONS. Igali, S. (Frederic Joliot-Curie National Research Inst. for Radiobiology and Radiohygiene, Budapest). pp 143-51 of STI-PUB-130.

Under certain experimental conditions native DNA of different origin reduced the back-mutation frequency of an Escherichia coli methioninless strain by a factor of 0.6 notwithstanding the dose ranging between 9 and 36×10^3 R. (auth)

22400 X-RADIATION DAMAGE OF SOME INFORMATIONAL MACROMOLECULES. Robev, S. K. (Inst. of Radiology and Radiation Hygiene, Sofia). pp 153-60 of STI-PUB-130.

Relatively simplified cellular and subcellular models of the x-radiation sensitivity of DNA-, RNA- and protein-synthesizing systems were studied. It has been revealed that a newly investigated phenomenon—the radiosensitivity of the ability of DNA to form isologic hybrids with an RNA—is characterized by a very steep dose-response curve. Some possible explanations of the relations within the genetically linked series—DNA on RNA-protein—in radiobiological aspects are discussed. (auth)

22401 RADIOGENETICAL EXPERIMENTS WITH HIGHER RESOLVING POWER IN MAIZE. Bianchi, A.; Contin, M. (Univ., Milan. Univ. Cattolica del S. Cuore, Piacenza, Italy). Atti Ass. Genet. Ital., 8: 257-67(1963).

Methods, having high resolving power in maize, have been evolved for the scoring of mutations in experimental populations; these methods promise to be useful for analyses of the nature of artificially induced mutations in this species. Besides the classical procedure which makes use of endosperm markers and the use of pollinator stocks possessing translocations between A and B chromosomes, the behaviour of w_x locus in chromosome 9 is presented. Mutations to W_x, which can readily be made visible in pollen grains of w_x plants by iodine staining were easily scored in such great cell populations. The resolving power of this experimental approach was equal to that of microbial genetics. X-irradiation of w_x plants with 560–1680 R, distributed within one week at the meiotic stages, increased the percentage of empty pollen grains (this demonstrated the efficiency of the treatment since they mainly result from chromosomal aberrations). The frequency of back-mutations (w_x to W_x) was not affected. Altogether the reported results conformed to the idea expressed, on the basis of previous analyses, and the rate of point mutations remained unchanged, at least under the conditions reported in the experiments with maize. Maize possesses in open pollinated populations a tremendous variability amenable only to "genic" mutations; results observed were contrary to this fact. (B.H.S.)

22402 MUTAGENESIS BY NEAR-VISIBLE LIGHT. Kubitschek, H. E. (Argonne National Lab., Ill.). Science, 155: 1545-6(Mar. 24, 1967).

Mutants resistant to bacteriophage T5 were produced both in continuous and in stationary cultures of Escherichia coli by near-visible light, 320 to 400 millimicrons, at rates greatly exceeding spontaneous rates in the absence of light. Aerobic mutation rates were about twice anaerobic rates, which shows that mutations were induced in either of at least two different processes. Mutations induced by near-visible light involve different photochemical processes than those induced by ultraviolet light. (auth)

22403 ANALYSIS OF POSSIBLE DIFFERENCE IN RADIOSENSITIVITY OF UNMARKED PATERNAL AND MATERNAL CHROMOSOMES. Vasin, B. N.; Urbakh, V. Yu. (Inst. of Biochemistry, Moscow). Radiobiologiya, 6: 568-73(1966). (In Russian).

Formulas for the calculation of the possible differences in the radiosensitivity of unmarked paternal and maternal chromosomes are derived. A numerical example is given. (J.S.R.)

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Refer also to abstracts 21858, 22137, 22239, 22276, 22342, 22364, 22365, 22494, 22515, 22551, 22571, 22572, 22593, 22602, 23234, and 23654.

22404 (AD-641191) RESEARCH TOWARD THE DEVELOPMENT OF EYE EFFECTS SAFE SEPARATION CHARTS. Final Report, May 31, 1965–May 31, 1966. Muller, Arthur F.; Wilson, Patrick W. Jr. (Technology, Inc., San Antonio, Tex. Life Sciences Div.). July 1966. Contract AF41(609)-2437. 89p. CFSTI $3.00 cy, $0.65 mn.

The purpose of this report is to make known the research methods, results, and conclusions involved in a study which was to develop eye safe separation distances from nuclear detonations in terms of yield, altitude, slant range, etc. Under

the precept that retinal temperature is the most significant factor in ocular damage, a mathematical model for the prediction of retinal temperature is outlined. Theoretical and empirical fireball source data are input separately to the model in an effort to determine the applicability of the theoretical data by comparing calculated retinal temperature rise. The results of the comparisons are favorable. However, it is concluded that, presently, the model retinal temperature predictions must be used with reservation. (auth)

22405 (AECL–1027(4th Ed.)) HEALTH AND SAFETY ORGANIZATION. Fourth Edition. Thacker, D. G. (comp.) (Atomic Energy of Canada Ltd., Ottawa (Ontario)). June 1966. 31p. Dep. mn. AECL Free.

Provisions for health and safety, with emphasis on radiation safety, are summarized. Topics discussed are derivation of legal authority, establishment of policy, assignment of operational responsibility, and provision of expert advice for management. (H.L.W.)

22406 (AEET–247) MEASUREMENTS ON AIRBORNE AND SURFACE FALLOUT RADIOACTIVITY IN INDIA FROM NUCLEAR WEAPON TESTS (RESULTS UP TO JUNE 1965). Vohra, K. G.; Rangarajan, C.; Gopalakrishnan, Smt. Sarada; Sadasivan, S.; Chitale, P. V. (Atomic Energy Establishment, Trombay (India)). 1966. 144p. Dep. mn.

Data compilations are presented from fallout monitoring stations in India. These include the daily and monthly airborne fallout beta activity, the daily and monthly surface fallout beta activity in rainfall, the concentrations of radionuclides in ground level air, and the monthly deposition of radionuclides. (C.O.)

22407 (EIR–103) FALLOUT IN REGEN, STAUB UND BODEN UND SEINE ABSORPTION IN PFLANZEN. (Fallout in Rain, Dust, and Soil and Its Absorption in Plants). Merk, Irene (Eidgenoessisches Institut fuer Reaktorforschung, Wuerenlingen (Switzerland)). Jan. 1967. 95p. (In German). Dep. mn.

The amount of radioactivity in plants is compared with the radioactivity of fallout samples. Those plants which have significance for human nutrition were especially considered. The Sr/Ca, Ca/K, Sr/K, Cr/Cs, and Sr/total-γ ratios were differentiated for all plant parts, and the root-plant discrimination factors were determined. From a great number of plants grown under clinical conditions and some grown under normal agricultural conditions it was shown that there was a good parallel in the content of individual isotopes and elements. Discrimination effects between various plant parts and between various plants attain an order of magnitude only in special cases (potatoes and tomatoes). The enrichment and depletion factors of the edible plant parts were determined. Potatoes showed an extremely low depletion factor. In the edible parts of the plants there was usually a depletion rather than an enrichment factor found. In 1964 the soil effect on the total activity of the plants could be neglected. Through a periodic research series with covered and uncovered plants and by discrimination of the different plant parts. satisfactory correction formulas could be found in order to eliminate the soil effect. The comparison factors calculated between the activity of the plant and that of the physical fallout samples showed which influences one must consider in contaminated plants. In appendices the methods used for the chemical analysis of the ^{90}Sr and Ca contents are outlined. (J.S.R.)

22408 (IA–914) RADIOACTIVITY MEASUREMENTS IN ISRAEL, SEPTEMBER 1961–JUNE 1963. Passy, N.; Feige, Y. (Israel Atomic Energy Commission, Yavne. Soreq Nuclear Research Center). Nov. 1963. 28p. Dep. mn.

Deposited activity is collected regularly at four fallout monitoring stations in Israel each of which is located in a different climatic region. Figures and tables summarizing the gross beta fallout measurements from September 1961, through June 1963, are presented. During this period fresh activity was released into the atmosphere by extensive series of nuclear weapon tests in the megaton range. (auth)

22409 (K–L–6131) BIOPHYSICAL LIMNOLOGY: THE ASSESSMENT OF LOW-LEVEL CONTAMINANTS IN NATURAL WATER. Lammers, William T. (Oak Ridge Gaseous Diffusion Plant, Tenn.). Feb. 24, 1967. Contract W-7405-eng-26. 24p. (CONF-670508–1). Dep. mn. CFSTI $3.00 cy, $0.65 mn.

From International Conference on Water for Peace, Washington, D. C.

Qualitative and quantitative fractionation of water borne particles using centrifugal techniques is described. Two basic fractionation schemes were designed. One was designed to isolate as individual fractions all groups of particles occurring in significant numbers in the water mass. This scheme was used to determine the patterns of differential accumulation of DDT, ^{60}Co, ^{137}Cs, and ^{106}Ru. The other fractionation scheme was designed to concentrate and isolate a single fraction from a water sample. This scheme was used in studies on the extent and nature of viral contamination of natural water. The identity and numbers of specific bacteriophage infecting three host species of bacteria are determined by plaque assay. Significant changes in human population numbers and seasonal changes were reflected in bacteriophage population numbers. Electron microscope examinations of virus particles revealed two classes of particles. One consisted of particles having both the protein coat and the nucleic acid core of an infective particle. The other class consisted of "ghosts" or outer coats of various types of particles having the size and morphology of known viruses but without the inner nucleic acid core. (H.L.W.)

22410 (NP–16543) DIETARY LEVELS OF ^{90}Sr, ^{137}Cs, AND ^{131}I FOR THE YEARS 1964–66. Interim Report, January 1, 1964–March 14, 1966. Wortley, G. (Joint FAO/IAEA Div. of Atomic Energy in Agriculture). Mar. 18, 1966. 12p. Dep. mn.

It is far too early to draw comparisons and conclusions on the effects of fallout on dietary levels and items of diet for the period 1964/66 as compared with 1961/63, as the data received so far are far from complete on the global scale. However, the data to hand so far indicate that the levels of strontium-90 and cesium-137 in items of diet and total diet rose to a peak during 1964 in some parts of the world, and showed a downward trend in 1965. The peak level of 1964, however, was not much greater than levels recorded in 1963 which was the highest up to that time. The 1964 levels would still not cause concern from the point of view of hazard to human health, and from this it follows that, unless more nuclear weapons tests are made in the megaton ranges, there will be no need to take precautionary measures for the protection of the public. (auth)

22411 (ORNL–4076, pp 141–74) NUCLEAR SAFETY. (Oak Ridge National Lab., Tenn.).

Research progress is reported under the following topics: activities of Nuclear Safety Technical Staff, correlations of fission product behavior, nuclear safety tests in major facilities, and laboratory-scale supporting studies. (M.C.G.)

22412 (ORNL–TM–1159) ENVIRONMENTAL STUDIES: RADIOLOGICAL SIGNIFICANCE OF NUCLEAR ROCKET DEBRIS. Semiannual Progress Report, January 1–June 30, 1965. Fish, B. R.; Clark, T. G.; Boyett, R. H.; Wilkie, W. H. Jr.; McWhorter, W. C.; Thompson, J. L. (Oak Ridge National Lab., Tenn.). Jan. 1966. Contract W-7405-eng-26. 44p. Dep. mn. CFSTI $3.00 cy, $0.65 mn.

Radiological safety studies were continued to determine the hazards which might result from radioactive debris from an accidental fragmentation of a nuclear rocket in space. The studies included the production of micron size particles, dosimetry of such particles which were made radioactive, the effects of the radioactive particles on body tissues, and a computer program for estimating tissue depth doses from reactor debris. The production of minute particles containing ^{89}Sr to simulate reactor debris is described in detail. A technique for inserting these particles into organisms is given. (L.C.L.)

22413 (TID–23709) SAVANNAH RIVER BIOLOGICAL SURVEY, SOUTH CAROLINA AND GEORGIA, MAY–JUNE AND SEPTEMBER 1965. (Academy of Natural Sciences of Philadelphia, Pa. Dept. of Limnology). Jan. 1967. Contract AT(07-2)-1. 165p. Dep. mn. CFSTI $3.00 cy, $0.65 mn.

For Du Pont de Nemours (E. I.) and Co., Aiken, S. C. Savannah River Plant.

Surveys were undertaken to determine whether any physical, chemical, or biological change had occurred in the Savannah River since the previous major surveys. The first series of surveys (1951–1952) was carried out before plant operation began—the second series (1955–1956) and the third (1960) after plant operation began. The 1965 surveys consisted of a spring survey from May 30 to June 8 and a summer survey from September 21 to September 30. The May–June survey was designed to determine the condition, of health, of the river in the vicinity of the Savannah River Plant during the period when many organisms are reproducing. It is also the time of year when the flow is usually high, although this was not the case during the spring survey. The September survey, carried out during low-flow, warm water conditions, was designed to determine the health of the river at a time of year when the environment is least favorable for aquatic life. In addition, these detailed surveys provided a check on the results obtained by the brief, quarterly surveys of Stations 1 and 6, which have been carried out for the past several years. (auth)

22414 FALL-OUT RADIONUCLIDES IN COLORADO DEER LIVER. Whicker, F. W.; Walters, R. A.; Dahl, A. H. (Colorado State Univ., Fort Collins). Nature, 214: 511–13(Apr. 29, 1967). (COO–1156–14).

Since deer liver is a choice food item it was of interest to assay samples for fallout radionuclides. Livers and rumen contents were obtained from wild mule deer during the period May 1963 to August 1964, and assay was performed on bulk samples using gamma-ray spectrometry, together with computer analysis. Typical gamma spectra are reproduced, and data tabulated. It was found that, with the exception of ^{144}Ce, the concentrations of the nuclides decreased at rates which were not statistically different between liver and rumen samples, suggesting equilibrium conditions. Concentrations of ^{144}Ce decreased at a significantly slower rate in the liver than in the rumen samples, indicating that the liver was not in equilibrium with environment for this nuclide. This suggests a relatively long biological half-time component for cerium in the liver. Since ^{137}Cs, ^{54}Mn, and ^{106}Ru concentrations in liver were judged to be in equilibrium with environmental contamination during the study, correlations between rumen content and liver concentrations for these nuclides were investigated. Statistically significant correlations were obtained for ^{137}Cs and ^{54}Mn, but not for ^{106}Ru. Estimates of average lifetime doses to the liver from the four principal gamma emitting nuclides are summarized. It was apparent that the major portion of the total dose (about 72%) would be from ^{144}Ce; only about 2% would be attributed to ^{54}Mn. Results indicate that the fall-out concentrations in the study area during the investigation were insufficient to present a hazard to deer liver tissue. It is believed that deer liver may be a useful bioindicator for environmental contamination by certain cerium, caesium, manganese, and ruthenium isotopes. (UK)

22415 USE OF LASER BEAMS AND THEIR POTENTIAL OCCUPATIONAL HAZARDS. Solon, Leonard (New York Univ.). Ind. Hyg. Rev., 5: 19-26(May 1962).

Applications of lasers and the associated hazards are reviewed. Formulae are now available for computing the retinal energy density from laser beams taking into account the pertinent laser and ocular parameters. The threshold for a chorioretinal lesion from a short pulse of blackbody radiation is of the order of 1 cal/cm^2 at the retina. Direct viewing of the field laser beam must be avoided. As to a permissible viewing intensity of a distant or far field laser beam a conservative estimate would be 0.01 cal/cm^2 at the retina, until further animal experimentation or clinical experience indicates that this level is excessively stringent. Other admonitions regarding persons occupationally connected with laser development or laser applications are given. At the intensities achievable with lasers, reflection of a laser beam from mirrors, doorknobs, or even highly polished furniture surfaces or walls could be dangerous. (TCO)

22416 STREAM SURVEILLANCE PROGRAMS. Weaver, Leo (Public Health Service, Washington, D. C.). J. Water Pollut. Contr. Fed., 38: 1334-44(Aug. 1966).

The design of stream surveillance systems is discussed in relation to experience of the Public Health Service's Division of Water Supply and Pollution Control. It is pointed out that effective surveillance programs should be dynamic and fitted to the needs of the data user. An example of changing surveillance needs is the monitoring of alpha and beta radiation levels in surface waters. Facets of program planning for control of stream pollution are discussed. (H.G.D.)

22417 THE OPEN-ENDED METAL COLUMN FOR THE DENTAL X-RAY MACHINE. Menczer, Leonard E. (City of Hartford Health Dept., Conn.). J. Amer. Dent. Ass., 73: 1083-9(Nov. 1966).

For reducing unnecessary radiation exposure of patients in dental radiography, the plastic pointer cone in the offices of dentists in private practice in the Greater Hartford Area was replaced by newly designed and fabricated open-ended metal columns of 8 different types. This new device eliminates extraneous, secondary, scatter and, in some instances, leakage radiation, thereby lowering patient exposure. Film fogging was also eliminated and more sharply defined radiographs were produced. Acceptance of the column approached 100%; 315 columns were installed in the offices of 260 local dentists. The manufacturers of dental x-ray equipment have also expressed interest in such an open-ended metal or shielded column. Other means of reducing patient and personnel x-ray exposure in dentistry are also discussed. These include: (1) replacing the mechanical or synchronous motor timer with an electronic timer (for x-ray machines made before 1955), thereby enabling the use of the fastest x-ray film available. An excellent dental radiograph can be obtained in a fraction of a second, so that the patient should not be exposed 2 or 3 sec for each radiograph. (2) Draping the patient with a leaded apron to reduce somatic and genetic exposure from leakage, secondary, and scatter radiation occurring in the use of the dental x-ray machine. (3) Using a film holder rather than exposure of the patient's hand in addition to tissues of the face and head. (4) Taking only such films as are diagnostically necessary. (BBB)

22418 A NEW METHOD OF INTEGRAL DOSE MEASUREMENT WITH A PLASTIC SCINTILLATOR PHANTOM (ON THE ACCURACY OF OUR MEASURING SYSTEM). Mural, Takeo; Nakamura, Tadashi; Hitomoto, Tamotsu; Sakamaki, Kimio (Tokyo Medical and Dental Univ.). pp 74-5 of 7th Japanese Conference on Radioisotopes, Tokyo, 1966. Tokyo, Japan Atomic Industrial Forum, Inc., 1966.

The quantity of the emitted fluorescent light from a phantom was measured as photoelectric current using an apparatus which is described. A plastic scintillator (28 × 28 × 15 cm) was used as a phantom. This was set in a light-tight box, with a photomultiplier tube (Toshiba 7696) attached to the box and facing the phantom. In the new method presented, an integral dose D_s/R in air under defined physical conditions of irradiation S was obtained as a standard. The photoelectric current I_s and the air dose rate at the surface of the phantom R_s are to be measured. Then the photoelectric current I_x will be obtained under given irradiation conditions for which the integral dose D_x is required. Thus, the integral dose D_x will be obtained using the equation: $D_x = D_s \times R_s \times I_x/I_s$. The frequency distribution of photoelectric current obtained for a unit dose rate under various combinations of size of field and intensity of dose showed the normal distribution. The mean was 19.2 and standard deviation was 0.69. Variation of photoelectric currents for an equal integral dose was very small when the central portion of the phantom was irradiated. It ranged from a maximum 102 na to a minimum of 93 na on the central circular area. In this method, D_s/I_s must be obtained every time measurements are made even using the same x-ray machine. To overcome this problem a standard radiation source of 500 mCi ^{137}Cs was used to obtain D_s' and I_s'; then D_x may be easily obtained. (BBB)

22419 PROBLEMS OF RADIOACTIVE CONTAMINATION IN THE SPHERE OF NUTRITION OCCASIONED BY TECHNICAL ATOMIC DEVELOPMENTS. A CONTRIBUTION TO THE DISCUSSION OF RISKS, CONTROL, AND PROTECTION POSSIBILITIES. V. FOUNDATION AND DEVELOPMENTS IN RADIOPROTECTIVE PRACTICE. Herbst, Willy (Univ., Freiburg i. B.). Vitalst. Zivilisationskr., 8: 256-61(Dec. 1963). (In German).

The author discusses the basic regulations for radiation protection as promulgated by the International Commission on Radiological Protection. Factors that affect protection from radionuclides include the degree of their biological incorporation, the extent of their introduction into food chains, the amounts of information relative to the effects of incorporated radionuclides, and the legal regulations pertaining to protection of the general population as well as those engaged in activities directly associated with use of radiation and radionuclides. In order to provide for a fruitful combination of biology and medicine with radiation protection, much more information will be required in the area of basic research in radiation effects and in incorporation studies. Also, in order to assure proper site selection and suitability of nuclear installations to their surroundings, the effects of various radionuclides on the biosphere require comprehensive study. The author discusses the possibilities of effective radiation protection by use of flexible adaptation to the environmental biosphere. (TSS)

22420 THE DESIGN OF A MEDICAL LASER LABORATORY: A PLANNED STRUCTURE TO REDUCE THE OCCUPATIONAL HAZARDS OF LASER RESEARCH. Goldman, Leon; Hornby, Peter (Children's Hospital Research Foundation, Cincinnati). Arch. Environ. Health, 10: 493-7(Mar. 1965).

Hazards to laser operators are reviewed and means to prevent them are presented. The important occupational hazards include damage to the eyes, damage to the skin and other organs, and burns from liquid nitrogen used as coolant. The medical laser lab must also be equipped for exposure of patients who may require minor surgical procedures, either pre- or post-impact. The safety system for the protection of the patient and the operating personnel should include: (1) a warning light system, initiated on charging of any high energy laser, which causes red lights at the benches to flash intermittently, (2) a muted bell system which commences on charging of the laser capacitor banks and continues until the laser is discharged, (3) individual door locks triggered by the laser charging circuits which prevent opening of the doors except in an emergency. (4) A master override switch so that personnel can leave these rooms in an emergency, (5) black curtains or screens to screen the personnel from the laser flash, (6) use of specially designed antilaser flash goggles for personnel working close to the laser head and for patients being exposed to the laser, (7) avoidance of specular surfaces by painting of rough walls with flat black paint, (8) avoidance of any open electrical connections, and (9) proper air-conditioning of the rooms. (BBB)

22421 PROTECTION OF PERSONNEL OPERATING LASERS. Goldman, Leon (Cincinnati General Hospital). Amer. J. Med. Electron., 2: 335-8(Oct.-Dec. 1963).

Effects of laser radiation on animal tissues are reviewed and the following measures for protection of personnel operating lasers are recommended: (1) The laser beam should not be observed directly whether the subject wears so-called protective glasses or not. The head should be turned away when the laser is fired, unless the laser operation is completely enclosed or surrounded by screens. (2) Personnel operating lasers should have their eyes checked (fundus examinations) at intervals by an ophthalmologist. (3) Any laser operator who has any after-image immediately after a laser firing should consult the eye doctor at once to determine whether or not retinal damage has occurred. (4) It is essential to avoid contact of the skin with the laser beam in any type of firing. (5) In work in high-energy lasers, contact of any portion of the body with the direct beam should be avoided, and if contact occurs, a physician should examine the site for immediate or delayed damage. (6) For work with high-energy lasers, protective creams or clothing that are presently available cannot be relied upon. (BBB)

22422 MAXIMUM PERMISSIBLE INTERPRETATION OF DOSE-EFFECT RELATIONS. Kellerer, A. M. (Univ., Munich). pp 91-8 of Biophysikalische Probleme der Strahlenwirkung. Muth, H. Stuttgart, Georg Thieme Verlag, 1966. (In German).

After a summary of the various possibilities for the interpretation of the dose-effect relation, the limitations of such interpretations are shown. The results obtained in the interpretation of the dose-effect relation as a distribution function of the inactivation dose are shown. (J.S.R.)

22423 GLYCERIN-PROTECTIVE EFFECT IN THE INACTIVATION OF YEAST CELLS (SACCH. CER.) BY X RAYS. Schmidt, W. F. (Freie Univ., Berlin). pp 177-81 of Biophysikalische Probleme der Strahlenwirkung. Muth, H. Stuttgart, Georg Thieme Verlag, 1966. (In German).

The glycerin-protective effects in the radioinduced inactivation of the yeast cells (Saccharomyces cerevisiae) were investigated. The results showed that the protective effect of glycerin cannot be explained by water extraction. The protective mechanism appears to be determined by whether the water molecule in the immediate vicinity of the macromolecule is replaced by glycerin. Then the molecule can be protected from the attack of the water radical and also the radiation chemistry of the water is modified in this area. The glycerin-protective effect can be explained by an absorption mechanism. (J.S.R.)

22424 DECONTAMINATION OF SURFACES AND OBJECTS CONTAMINATED WITH RADIOACTIVE MATERIALS. IV. EXPERIMENTAL PART. USE OF INDIGENOUS LAUNDERING AGENTS FOR THE DECONTAMINATION OF TEXTILE MATERIALS. Pihuleac, I. Rev. Chim. (Bucharest), 17: 697-702(Nov. 1966). (In Rumanian).

In order to protect later users, contaminating radioactive materials must be removed from special protective equipment or ordinary clothing by washing them in special laundering solutions. Tests carried out with cotton specimens soaked in aqueous solutions containing ^{131}I, ^{131}Ba, ^{32}P, ^{141}Ce, and ^{59}Fe revealed that best results were obtained by washing them with a solution containing 0.2% of a detergent and 0.3% of a complexing agent, such as sodium hexametaphosphate or sodium EDTA. Three washing and rinsing cycles of 5 min duration each were found to be best. The detergents Dero-40, Penetrol, and Alba Super, of Rumanian manufacture, were used in the tests which were carried out by determining the count rate at various stages of the decontamination process. (TTT)

22425 DOSE vs DOSE RATE IN HAULING UNDERWATER RADIOACTIVE SOURCES (A PROBLEM OF HEALTH PHYSICS IN A SWIMMING POOL REACTOR). de Franceschi, L. (CAMEN, Pisa, Italy). Health Phys., 13: 517-19(May 1967).

Calculations are presented for the situation of a man leaning over the water surface of a swimming pool type reactor and lowering or raising a gamma-active sample. (UKAE)

22426 DOSE-EQUIVALENT RATE FROM COSMIC RAY NEUTRONS. Watt, D. E. (United Kingdom Atomic Energy Authority, Chapelcross, Scotland). Health Phys., 13: 501-7(May 1967).

On the basis of published data from cosmic ray studies, the dose-equivalent rate due to naturally occurring neutron radiation is calculated to be 11.8 ± 1.0 mrem/yr for a small piece of tissue in air at sea-level and at a location with geographical coordinates lat. 55°2'N, long. 3°21'W. It is deduced that the neutron dose-equivalent (D.E.) experienced by the population at sea-level for isotropic irradiation varies from 6.2 ± 0.5 mrem/yr at the surface of the body to 56 percent of this value at 10 cm depth, assuming the body is represented by a semi-infinite slab of tissue 20 cm thick. The average D.E. rate at the surface of the body for persons flying at supersonic transport altitudes (~65,000 ft) ranges from 0.20 to 0.40 mrem/hr, depending upon whether the sun is at sunspot maximum or minimum. Experimental measurements, using the spherical moderator technique, confirm the calculated values for the natural dose-equivalent rates. (auth)

22427 A METHOD FOR THE ESTIMATION OF THE RESPIRATORY DEPOSITION OF AIRBORNE MATERIALS. Shleien, B.; Friend, A. G. (Dept. of Health, Winchester, Mass.). Health Phys., 13: 513-17(May 1967).

Since particle size distribution varies with time and environment, the degree of respiratory deposition for an exposed population is often difficult to assess. A solution to this problem is attempted by use of two mathematical models tied together by linear programming techniques. The first model shows aerosol particle size as a function of filter collection efficiencies; the second shows deposition in the nasal, tracheobronchial, and pulmonary regions of the respiratory tract as a function of particle size. Some experimental data are given for various fall-out radionuclides and subjected to the mathematical analysis. (UKAE)

22428 RADIATION DOSE TO THE RESPIRATORY SYSTEM DUE TO RADON AND ITS DAUGHTER PRODUCTS. Haque, A. K. M. M.; Collinson, A. J. L. (Borough Polytechnic, London). Health Phys., 13: 431-3(May 1967).

Annual radiation doses to the respiratory system due to radon and its daughter products were calculated in various working environments of the London area. The method analyzed was based on an accurate calculation of the energy dissipation of α-particles in the vulnerable tissue (1 μ-diameter and located at various depths) from the daughter activity deposited on the walls of the respiratory system; the equilibrium daughter activity was calculated from the deposition rates and the mucous movement. The proportions of the daughter activity present as free ions in air were calculated from extensive published theoretical and experimental results. As a more realistic lung model, an extensive set of experimental data on aerosols, and a more precise calculation of energy dissipation, among other things, were employed in the study; it is claimed that the method used is an advance on those of other workers. The radiation dose was found to be highest in segmental bronchi; in comparison with other results, the present calculation almost always gave higher values. The annual radiation dose at a depth of 30 μ from the top of the mucous layer in segmental bronchi was 13.8 rad for the highest radon concentration met in the study, viz. 10.1×10^{-12} Ci/l for a dealer in luminescent clocks. In view of the findings, it is felt that the present MPC value for radon should be revised downwards. (auth)

22429 EXCRETION OF URANIUM BY RATS FOLLOWING INHALATION OF URANIUM DIOXIDE. Downs, William L.; Wilson, Herbert B.; Sylvester, George E.; Leach, Leonard J.; Maynard, Elliott A. (Univ. of Rochester, New York). Health Phys., 13: 445-53(May 1967).

Rats were exposed to an aerosol of uranium dioxide (5 mgU/m^3) for periods of 17 to 140 days. Twenty-four hours after termination of exposure, the respiratory tract concentrations varied from 45 to 410 μgU/g, depending on the exposure time. Biological half-times for respiratory tract retention, based on a single exponential expression, were 141, 169, 239, and 289 days for exposure times of 17, 20, 58, and 140 days, respectively. A fit of the retention data to the power function ($y = At^{-k}$) was obtained by computer analysis. Significant amounts of uranium were excreted in the urine and feces only during the first month after exposure. (auth)

22430 RESPONSIBILITY AND JUDGEMENT: INTERPLAY IN HEALTH PHYSICS DECISIONS. Dunning, Gordon M. (Atomic Energy Commission, Washington, D. C.). Health Phys., 13: 509-12(May 1967).

The subject is discussed in regard to establishing standards for radiation protection in nuclear weapons testing, and in connection with radiation protection guides (with particular reference to ^{131}I). (UKAE)

22431 SOME PROBLEMS IN DECONTAMINATING STEEL BY THE ELECTROLYTIC METHOD. Miazek-Kula, Maria. Prace Cent. Inst. Ochrony Pracy, 17: No. 52, 59-65(1967). (In Polish).

Investigations on the decontamination of steel by the electrolytic method are discussed. The effect of the magnitude of the electric charge transmitted by the electrolyte and the effect of changes caused on the steel surface during the electrolytic decontamination process upon the degree of decontamination attained after subsequent further contaminations were the points considered. The electrolytes used to decontaminate acid-resistant steel contaminated with ^{60}Co were citric acid, oxalic acid, and sulfuric acid. It was found that within a certain range, the magnitude of the

charge transmitted by the electrolyte was without influence on the degree of decontamination. Under certain conditions of the electrolytic decontamination process, changes of the steel surface occurred that led to a decrease in the degree of decontamination after further contaminations of the sample were examined. (auth)

22432 CORRELATION OF ^{90}Sr CONTENT IN RAW AND THERMALLY TREATED FOOD PRODUCTS. Belova, O. M.; Dibobes, I. K.; Dubrovina, Z. V. Gig. Sanit., No. 3, 40-2(Mar. 1967). (In Russian).

Studies were undertaken dealing with the strontium-90 activity ratio of raw and cooked foodstuffs: cereals, flour, bread, milk, dairy products, meat, bones, vegetables, and root-crops. The findings are expressed in absolute activity values and in relative indices (per gram of calcium). (auth)

22433 ON DOSIMETRY IN PATIENTS' TEETH AND JAWS. Sonnabend, E. (Univ., Goettingen, Ger.). Stoma, 14: 231-9(1961). (In German).

Dosimetric measurements were made with double layers of films and with ionization chambers in the region of the teeth and jaws, and in the region of the gonads of patients during dental radiography. The sensitivity of the film covered the range from 0.002 to 30 R and the chambers covered a range from 0.00002 to 40 R. The x-ray source used ranged from 50 to 90 kV. Measurements with the film at the surface of the cheeks ranged from 200 to 3300 mR and with the chamber the values observed were between 275 and 5800 mR. Generally, the measurements made with the chamber did not show a direct proportionality to the film measurements, but they did tend to be moderately greater than the results with film. These differences ranged from 10 to 50% greater. At a voltage between 50 and 60 kV the film dosages measured by the film were about 30% less than the dosages measured by the ionization chamber. When a longer tube was used at these same voltages the measured differences were considerably less. No significant differences were observed when an Al filter was used. In a few of these cases the value as measured by the film was higher even than the value indicated by the chamber. As far as these differences exceed a scatter range of 30% they seem to be related to differences in wave length of the x radiation. Probably the measurement error of the ionization chamber is about 30% and that of the film is about twice as much. (BBB)

22434 DEVELOPMENT AND ORGANIZATION OF MONITORING OF THE ENVIRONMENTAL RADIOACTIVITY WITH SPECIAL EMPHASIS ON THE MONITORING OF THE CONCENTRATION OF RADIOACTIVE MATERIALS IN FOODSTUFFS. Krusen, Felix. Deut. Lebensm.-Rundsch., 59: 172-6(June 1963). (In German).

Radiation monitoring of environmental radioactivity is extensively conducted in the vicinity of nuclear installations, such as the Berlin research reactor, the nuclear research reactor at Juelich, and the experimental nuclear power plant at Kahl-Main. Radioactivity present in the air environment generally is continuously monitored by stations located at Aachen, Berlin, Emden, Essen, Hannover, Koenigstein/Taunus, Munich, Nuernberg, Schleswig, Stuttgart, and Saarbruecken. Five other stations make collections of radioactive samples. These are located at Cuxhaven, Emden, Husum, Oberstdorf, and Passau. At Koenigstein ^{90}Sr, ^{89}Sr, ^{95}Zr, ^{95}Nb, $^{106}Ru-^{106}Rh$, ^{140}Ba, ^{141}Ce, ^{144}Ce, ^{131}I, ^{137}Cs, and ^{185}W are measured specifically. Other stations monitor waters of the Rhine, Saar, Moselle, Nahe, Lahn, Danube, Necker, Ems, Weser, Elbe, and the Mittelland Canal. Radioactivity in drinking water and ground waters is closely supervised by stations located throughout the states of Baden-Wuertemberg, Bavaria, Hesse, Lower Saxony, North Rhine-Westphalia, Rheinland-Pfalz, and Saarland, and at the cities of Berlin, Bremen, and Hamburg. The results of all measurements are submitted to regional centers where they are reviewed and published by the Federal Atomic Energy Ministry. These are also circulated to the ENEA, OECD, UNSCEAR, IAEA, FAO, and WHO for information and further study. (BBB)

22435 OCCUPATIONAL HEALTH PROGRAMS IN CIVILIAN NUCLEAR POWER REACTOR FACILITIES. Spickard, John H. (Atomic Energy Commission, Idaho Falls, Idaho). J. Occup. Med., 8: 261-2(May 1966).

This study reports health services information received from 10 civilian nuclear power facilities. The plant personnel populations are small, and medical programs have been established at all sites generally through a local physician or clinic. All facilities anticipate using local hospitals for treatment of seriously injured personnel. Estimates place the annual cost for medical services at $100 per employee. A table summarizes the administration, staff, and examination programs at these plants. Analysis of urine for radionuclides is done routinely at 9 facilities, whereas whole-body counting is done at only 1 facility at infrequent intervals. Evidence obtained at the National Reactor Testing Station demonstrates that radiological urinalysis is inadequate as a general monitoring technique for internal contaminants. Of 31 different radionuclides encountered in human subjects by whole-body counting, only 4 were excreted in significant amounts in the urine. Although small reactor sites cannot afford elaborate whole-body counting facilities, portable body counters adequately sensitive for practical personnel protection are available. Another problem of great concern at the small nuclear-energy plant is that of handling the radioactivity-contaminated casualty. Small plants have minimal facilities and must depend upon reactor personnel, local physicians, and local hospitals for immediate treatment. Planning for such emergencies is discussed. (BBB)

22436 IS SELF-PROTECTION POSSIBLE? Schaefer, Klaus Tech. Landwirt., 18: 10-12(Jan. 15, 1966). (In German).

The danger to rural human populations from atomic warfare is not so much from use of large bombs but from the use of tactical nuclear weapons. The area of destruction from these weapons is at most 1 km in diameter. Since they are designed for use against military targets that are widely dispersed, they represent a great threat to the population in agricultural areas. The greatest danger from these weapons is from the radioactive dust produced. Usually the farm cellar will provide adequate shelter and it should be possible to reach it well before any radioactive fallout appears. Cattle should be brought into their stalls, although these offer less protection nowadays when barns are less solidly constructed than before. Once in the stall, animals should be milked and fed and water intake should be restricted. Windows and doors should be sealed off. Feed should be well protected against radioactive fallout, because consumption of contaminated feed is usually far more serious than external irradiation from fallout. Feed stored in a silo is far better protected than in the field. Tools necessary for emergencies are usually available on modern farms. A portable electric generator should be made available to operate fresh water pumps, for milking, and for operation of a refrigerator. (BBB)

22437 RADIATION EXPOSURE IN X-RAY DIAGNOSIS. Frik, Wolfgang (Technische Hochschule, Aachen). Radiologe, 6: 310-15(Aug. 1966). (In German).

Radiation dosage varies considerably with the type of x-ray examination. As compared with exposure to a volume dose of 7500 rad kg, a thoracic fluoroscopy and photograph amounts to 0.2%, a shielded thoracic exposure is 0.1%, an intravenous pyelogram or gastrointestinal study each amounts to 1.3%, photographs of the lumbar spine in 2 planes is 0.7%, and a barium enema study amounts to 1.5%. As compared to a gonadal dose of 5 R, which is the natural exposure during the reproductive age span, these procedures are equivalent to 0.05%, 0.015%, 6%, 0.04%, 1.2%, and 6% respectively, in men. In women these procedures produce slightly greater exposures. Grossly evaluated, each mR of exit dose is equivalent to 0.03 to 1.5 R of skin dose. During abdominal fluoroscopy the incident surface dose is about 50 to 300 R/cm^2/min. There does not seem to be any statistically apparent relation between abdominal surface dose and gonadal dose. The volume dose during abdominal photographs with a field size of 100 cm^2 has been calculated to be between 0.05 and 0.15 rad Kg/mR exit dose. For thoracic photographs the volume dose is higher by a factor of about 10. This factor may be as great as 12, when the radiation attenuation in the thorax and the larger absorption of scattered radiation in adjacent portions of the abdomen are taken into account. The total-body mass also plays a part here. Studies that are tabulated indicate a close relation between irradiation exposure and the configuration of the equipment. One system that tends to reduce overall irradiation exposure is the use of 70-mm photographs taken at the shielded exit of an image intensifier. Dose reduction with an image intensifier-television monitor system is optimized if the dose at the system input is kept constant. It averages 40% less than with conventional fluoroscopy without automatic dose input. Other factors, such as tube voltage and selective rasters, also affect gonadal dose. (BBB)

22438 EXTERNAL EXPOSURE TO ^{41}Ar RELEASED FROM MULTIPLE SOURCES. Imai, Kazuhiko; Iijima, Toshinori (Japan Atomic Energy Research Inst., Tokyo). J. Nucl. Sci. Technol. (Tokyo), 3: 522-7(Dec. 1966).

A code was developed for the calculation of external exposure to radioactive cloud from several reactors with different stack heights and release-rates. Using this code, the resultant exposure rates for ^{41}Ar released from three reactors with assumed release rates were obtained to cover the area in and around the Tokai nuclear site, and isopleths were drawn under different wind directions. In the case of NE-wind, mutual superposition of the effects from the three sources must be taken into consideration, while in other cases the effect of each source may be considered

independently. The annual exposure does not exceed 100 mR in the populated zones with the release rates assumed in this study. (auth)

22439 APROPOS OF A PROTECTIVE PROSTHESIS IN THE COURSE OF INTERSTITIAL CURIETHERAPY IN CANCER OF THE LOWER LIP. Grellet, J.; Lecacheux, B. Rev. Stomatol. (Paris), 66: 615-20(Oct.-Nov. 1965).

Problems encountered in radiotherapy of the lower lip with reference to protection of the mandible are discussed. Two ways are proposed: use of a shield of high at. no. and implantation of Ra needles to give a high tumor-low tissue dose. Methods are described for construction of methacrylate prostheses for use with Ra. Calculation of the dose with Ra implants is made in three ways. Measurements showed that with 4 needles and 2 mg of Ra in place for 6 days the dose at the anterior portion of the mandible had decreased 50% with the prosthesis as compared without it. The 2000-R isodose contour included only 9% of the mandible with and 17% without the prosthesis in place. The 6-day tumor dose was estimated to be 10,000 R. With the prosthesis, in addition to protection of the mandible against radionecrosis, the tongue is also protected. Use of ^{192}Ir and ^{198}Au for interstitial therapy is also discussed, as well as construction of protective prostheses to be employed with them. (BBB)

22440 SCINTILLATION BRAIN SCANNING IN CHILDREN. David, Ronald B.; Beiler, David; Hood, Henry; Morrison, Samuel S. (Geisinger Medical Center, Danville, Pa.). Amer. J. Dis. Children, 112: 197-204(Sept. 1966).

Brain scanning in 220 children with various radioisotopes is reported, with special consideration of the radiation doses involved and reduction of them by use of certain techniques and selection of isotopes. Reasons are given for using ^{197}Hg rather than ^{203}Hg in children. It is best to use only ^{197}Hg in children because of the smaller whole-body radiation dose. The dose of ^{197}Hg to be given is determined on a weight basis: 100 μC for children under 15 lb, 250 μC for children between 15 and 50 lb, and 500 μC for children between 50 and 100 lb, and a full adult dose of 1 mC for children over 100 lb. A table gives the calculated radiation doses for the various agents used in radioactive brain scans. Whole-body doses are given in mrad/100 μC, and kidney doses in rad 100/μC. Figures are given for chlormerodrin-^{197}Hg and ^{99m}Tc-pertechnetate. Of the agents now in common use, ^{197}Hg delivers the lowest total-body dose and a much lower kidney dose than ^{203}Hg. Most preparations of ^{197}Hg contain less than 5% ^{203}Hg as a contaminant, the proportion of ^{203}Hg increasing with time because of its longer half-life. Pertechnetate-^{99}Tc is perhaps the best available isotope for brain scanning. It does not significantly improve the accuracy of diagnosis, but it gives the smallest total-body dose per millicurie and if the thyroid is blocked with perchlorate it is given no important ciritical-organ dose. Its main advantages are increased speed of scanning and its single γ-ray of 140 keV, which is ideal for scanning. The shortened scanning time and lower radiation dose are particularly important in children. Comparison is made between radiation dose and usual background irradiation. Included for comparison are examples of radiation doses encountered in common x-ray examinations. Although the renal doses with radiomercury are higher than these, it is noted that the whole-body doses are generally much smaller. With ^{99m}Tc the radiation dose is even less if similar doses are given, and even with considerably larger doses there is no critical-organ dose. The ultimate genetic and carcinogenic effects of any radiation exposure remain a problem of conjecture and concern, but in doses of this magnitude are probably negligible. (BBB)

22441 SUMMARY AND CONCLUSIONS OF THE CONFERENCE ON MEDICAL USES OF RADIUM AND RADIUM SUBSTITUTES. Chadwick, Donald R. (Public Health Service, Washington, D. C.). Amer. J. Public Health, 56: 1943-7(Nov. 1966).

Hazards encountered in the therapeutic use of Ra are reviewed and steps that may be taken to minimize them are presented. A survey revealed that Ra is still commonly used despite the ready availability of other radiation sources, and that it is often used with little precaution against unnecessary exposure. The accepted procedures of the AEC as to storage, handling, leak testing, and personnel monitoring when using radioisotopes are reviewed. It is suggested that all naturally occurring radionuclides including Ra, Rn, and Th, as well as accelerator-produced radionuclides, should be subject to the same radiation protection regulations as are reactor-produced radionuclides. Because of the special contamination hazards associated with Ra, due to its physical and chemical properties, minimum standards of source design, construction, and testing should be established for this radionuclide by appropriate experts. A suitable substitute for Ra, with less contamination hazard, is desirable. Cesium-137 sources seem capable of satisfying most requirements. It is also recommended that research be directed to the development of better radiation sources for brachytherapy. The development of new techniques such as afterloading procedures, to reduce unnecessary personnel exposure in the therapeutic application of radionuclides is also important. (BBB)

22442 REDUCTION OF PERSONNEL EXPOSURE IN GYNECOLOGICAL RADIUM APPLICATIONS AT THE RADIOTHERAPY CLINIC 1953-1964. Rytilae, Aaro (Univ. Central Hospital, Helsinki). Ann. Chir. Gynaecol. Fenn., 54: 331-4(1965).

In the period 1953 to 1964 measurements were made on gynecologists and assistants involved in the insertion of radium applicators, with pocket dosimeters and photographic films carried in breast pockets and on hands. The annual average exposures for individuals in 1964 was as follows: gynecologists 3.5 rem, nurses 1.3 rem, x-ray personnel 0.2 rem, and ward assistants 1.7 rem. The hand doses of hynecologists were measured with plastic finger rings in the period 1962–1964. The results showed a decrease in 1963 and 1964 to 10 and 8 rem, respectively, from 28 rem in 1962. In 1963 the average hand dose per Ra application varied from 40 to 55 mrem. The average quantity of radium used was 130 mg per application. Thus the doses to medical personnel have been reduced yearly, although the use of Ra has increased from the year 1955. This resulted from the fact that the shielding was improved. These measurements indicate that the gynecologists received less than the maximum permissible doses. (BBB)

22443 CONTRIBUTIONS TO THE PHYSICS OF TELECOBALT THERAPY, WITH SPECIAL REFERENCE TO THE BUILD-UP EFFECT. Rosenow, U. (Univ., Goettingen, Ger.). Fortschr. Geb. Roentgenstr. Nuklearmed., 103: 618-24(Nov. 1965). (In German).

Because of the buildup effect irradiation with ^{60}Co produces a dose maximum only at a tissue depth of about 5 mm. This maximum is relatively flat. The biological effect of skin protection extends primarily only to the first 2 mm. With ^{60}Co and other elements with high radiation energies there is some leeway for the buildup effect, because usually less than the tolerance dose is administered. In practice, changes in the buildup effect need to be kept in mind only for the most extreme conditions where oblique radiation angles and filters are used adjacent to the skin. However, in ^{137}Cs therapy the buildup effect must be very closely watched, because the buildup effect extends for scarcely more than one mm. In addition, the buildup effect depends on the size of the shield opening, the electron filter, the filter material, the filter thickness, the relative density of the exposed tissue, the anterior scattering that affects the homogeneity of the dose distribution, and the temperature. (BBB)

22444 EXPERIMENTAL CONTRIBUTION ON THE PROBLEM OF THE RESORPTION AND REMOVAL OF RADIOACTIVE SUBSTANCES FROM THE BURNED SURFACE. Benes, A. (Chirurgicka Klinika, Hradec Kralove, Czech.). Zentralbl. Chir., 90: 1121-5(1965). (In German).

Burned surfaces of skin and wounds contaminated with radioactivity can be decontaminated by washing with water or excision. The most effective way is to excise vessels or remove the tissues entirely. As shown by studies in rats, up to 80% of the initial contamination with ^{32}P and ^{90}Sr can be removed by use of a plastic adhesive bandage made of polyvinylbutyrate. Intraperitoneal administration of one ml of a neuroplegic drug mixture of panthesin, sandosthen, and DH-ergotoxin within 6 hr resulted in the excretion of 40% of the initial radioactivity. After 6 hr 60% of the initial radioactive contamination can be removed within one min with a wet swab, regardless of whether water, 3% EDTA, 2% Na metaphosphate, or 2% DTPT is used. Sorption occurs faster with grade III burns than with grade II burns. The sorption of ^{32}P is slower than that of ^{90}Sr. Sorption of ^{131}I and ^{137}Cs is very rapid. Use of plastic bandages and a neuroplegic drug mixture accelerates sorption of ^{32}P and decreases resorption of ^{90}Sr. (BBB)

22445 BASIC PRINCIPLES FOR THE USE OF RADIOACTIVITY IN MEDICINE. VII. RADIATION BURDEN AND RADIATION DANGER. Rach, Klaus (Freie Univ., Berlin). Roentgenpraxis, 19: 70-4(Mar. 1966). (In German).

The author reviews briefly the question of radiosensitivity and the effects of single acute whole-body irradiation. Genetic radiation injuries are defined and compared with manifestations of somatic injuries. Gonadal exposure from a thoracic x ray amounts to 0.04 mrem. In Berlin the naturally occurring radiation exposure of the gonads amounts to about 10 mrem/month. In the Swiss mountains, because of the radiation from the rocks it is about 26 mrem/month. One month's gonadal exposure to radiation at this rate is equivalent to 400 thoracic x rays. The environmental gonadal radiation burden is compared with the exposures received from other radiation sources. Legal regulations for use of radiation and radiation protection are discussed. (BBB)

22446 ANALYSIS OF RADIOISOTOPE UNITS IN NINE GENERAL HOSPITALS. Wilson, John A. (Home for Crippled Children, Pittsburgh). Hosp. Topics, 44: 53-61(May 1966).

The use of radioisotopes by hospitals is considered in terms of licensing for use, professional control, size, and location of facilities, equipment, cost and charges, personnel, and safety supervision. A detailed survey is made of these and other features in 9 large hospitals as a result of a 54-item questionnaire. The data showed that the number of pieces of radiation-detection equipment in a given unit is directly related to the size of the patient load; the 4 units carrying out more than 1300 procedures averaged 10.3 pieces. The percentage of isotopes discarded before use because of decay to the point of ineffectiveness is given. Units engaging in research utilized an average of 9.2 isotopes; hospitals not so engaged averaged 6.5. The procedures carried out in the reporting hospitals are listed in a table. Although more than 30 procedures are given, 4 account for 64% of the total number. In 5 hospitals offering radioisotope therapy the nurses do not wear film badges; in 3 they do. Six of these 8 hospitals do not have special nursing units for patients receiving radioisotope therapy. Other features of radioprotection in the hospitals surveyed are reported in detail. Two of the units are not monitored for stray radiation. No correlation was apparent between the number of procedures carried out annually and the frequency of monitoring, but the latter did correlate with whether or not the unit engages in research. None of the units engaging in research was monitored less frequently than biweekly. In only 2 hospitals do the radioisotope personnel not receive regular medical examinations. None of the hospitals reported an instance of overexposure or contamination requiring the services of an outside agency. (BBB)

22447 X-RAY SPECTRA FROM DENTAL X-RAY GENERATORS. I. SOME GENERAL CHARACTERISTICS. Barr, John H.; Garcia, Daniel A. (Tufts Univ., Boston). Oral Surg., Oral Med., Oral Pathol., 22: 478-88(Oct. 1966).

Spectral distributions for emissions of representative dental x-ray generators, under various operating conditions characteristic of contemporary practice, are presented. The influence of various controlling factors was delineated, and some preliminary observations of absorption effects reported. The different spectra recorded represented a range of approved emissions, each in wide general use by dentists for identical radiographic purposes. The resulting images differ widely in contrast characteristics (if not in density) and, therefore, in their diagnostic acceptability. The exposure dose to the patient under these diverse conditions will necessarily vary by a factor of almost 2. These observations indicate the need for a better definition of radiographic objectives, so that the most suitable and efficient x-ray emission for meeting these objectives can be identified and the differences reconciled as far as possible. (BBB)

22448 A DEMOUNTABLE PHANTOM OF VARIABLE GEOMETRY FOR INTRAPELVIC DOSIMETRY IN PREGNANCY: PRELIMINARY REPORT. Nikl, I. (Frederic Joliot-Curie National Research Inst., Budapest). Brit. J. Radiol., 38: 472-4(June 1965).

To determine the dose from radiographic exposure during pregnancy, both to the embryo in different phases of development and to the maternal genitalia, an inhomogeneous, demountable, and adjustable phantom was built. Dose measurements were carried out at numerous sites, ranging from 3 to 24 according to fetal size, to assess the dose both at the cranial and breech positions. Measurements were carried out on 3 different abdomens and 7 fetuses of different sizes for 15 different positions of the ovaries. All these measurements were made with 13 different beam directions that might reasonably occur during pregnancy. In addition, all measurements were carried out with 3 different x-ray qualities: normal quality (81-kV) x rays with both inherent and added filtration, and with hard (110-kV) x rays. The whole-body dose distribution for the fetus is shown by isodose curves interpolated from these readings. Doses for the various positions of the ovaries and the dose at the incident axial point could be recorded. As an example, dose values obtained during antero-posterior and postero-anterior radiographs of the abdomen during late pregnancy are illustrated. (BBB)

22449 RADIOISOTOPIC PLACENTOGRAPHY. Taehti, E.; Rytilae, A.; Voutilainen, A. (Inst. of Midwifery, Helsinki). Ann. Chir. Gynaecol. Fenn., 54: 316-19(1965).

Estimations of patient dose were made in the course of placentography with ^{131}I-labeled serum albumin. The patient is given 10 drops of Lugol's solution 3 times a day for at least 1 day, and preferably for 3 days, before the examination. This is done to prevent uptake of radioiodine by the maternal and fetal thyroid glands. Then ^{131}I-serum albumin is injected intravenously. Twelve fields of equal size are traced on the patient's abdominal skin and the number of impulses from them are counted with a scintillation counter. The placenta was localized in 13 patients by the method described. Placenta previa was diagnosed in 4 cases and verified later at cesarean section. A false result was obtained by isotope placentography in 2 patients who were given a small dose, 2 μC. When the investigation is performed carefully, the radiation exposure of both the mother and fetus is small. The dose received by critical organs of the mother, assuming that the patient weighed 70 kg with a 4000 ml blood volume, was calculated. The total dose to blood is 87 mrad and the total-body and gonad dose is 44 mrad. On the average, 0.006 μC of ^{131}I crosses the placenta per 5 μC RISA administered to the mother. Assuming a 300-ml blood volume, this will contribute a dose of 1 mrad to the blood. There is also a contribution to the blood and gonads from the ^{131}I circulating in the mother. The β rays from the mother will all be absorbed by the amniotic fluid, so that the additional dose to the fetus will be less than 4 mrad. This results in a total-body and gonad dose to the fetus of 5 mrad. (BBB)

22450 THE ACHIEVEMENT OF A COMMON STANDARD FOR DOSAGE STATEMENT IN RADIOTHERAPY. Massey, J. B. (Christie Hospital and Holt Radium Inst., Manchester, Eng.). pp 425-36 of Atti Colloq. Rapp. Fis. Med. Levico, Roncegno Terme, Sept. 14-19, 1964. Trento, Arti Grafiche Saturnia, 1965.

The techniques used by a physicist, associated with a radiotherapy department, to assure that radiation hygiene is enforced in the use of various types of equipment are described. In considering whether the equipment is working properly, he must be concerned with such problems as the x-ray tube voltage and filtration which control the penetrating power of the radiation. The collimating system should be correct, defining a beam of the proper size. It is only when the radiation beam quality and collimation are correct that % depth dose data and isodose charts can be used. Although absolute accuracy in the statement of dose delivered to the patient is desirable, it is even more important that all radiotherapists, in all centers and at all times, should mean exactly the same thing when they state that a particular patient was given a dose of 5500 rad, for example. It is only if this is so that previous experiences at the same and different centers may be profitably exchanged and used to improve techniques. Various dosimeter techniques are examined and evaluated. It is important that the calibration of the dosimeter should be checked periodically for changes in both over-all sensitivity and in its response to different qualities of radiation. Calculation involved in examining the data and its interpretation are discussed. (BBB)

22451 HOW A STATE HEALTH AGENCY PREVENTS OCCUPATIONAL DISEASE. Lieben, Jan; Hill, Philip C. (Pennsylvania Dept. of Health, Harrisburg). Ind. Med. Surg., 35: 489-94(June 1966).

State regulations and their enforcement relating to ionizing radiation and other occupational hazards are surveyed. The advisory Health Board of the State Health Department adopted a Regulation for Radiation Protection in October, 1956, which applies to all sources of ionizing radiation including radiation machines and radioactive material. Thus the x-ray equipment in hospitals, medical and dental offices and that used in industry as well as radioactive material utilized by the medical profession and industry come within its scope. The registration of all such sources was required by the Regulation. Included also was a section which outlawed the use of fluoroscopic devices for selling footwear. The registration requirement of the Regulation, with its provision for periodic re-registration, affords a list of all users of radiation in the state that totals almost 9000, of which more than 5000 are dental x-ray machines. A program of inspection of dental and medical x-ray equipment and concurrent education of the profession in the radiation hazards of their work and in the possible needless exposure to their patients were undertaken. An inspection program showed that radium was casually and improperly handled by many who apparently were unaware of or disregarded its potentially harmful properties. Radium needles for medical use were found stored without shielding in desk drawers, in filing cabinets or in locations adjacent to the patients' rooms in hospitals. Many were found to be leaking. Recommendations for proper handling techniques, for adequate shielded storage facilities, and for periodic leak-testing of sealed sources were provided. The extensive decontamination procedures required in 2 buildings formerly used for radium processing are described. (BBB)

22452 ^{14}C: SOME PROPERTIES, ENVIRONMENTAL DISTRIBUTION, AND POSSIBLE INFLUENCE ON THE HEREDITARY MATERIAL. Rava, Patrick A. (E. R. Squibb and Sons, Inc., New Brunswick, N. J.); Haughey, Francis J.; Sonnenblick, B. P. J. Newark Beth Israel Hosp., 16: 109-18(Apr. 1965).

Carbon-14, because of its incorporation into many molecules of biological importance including DNA, must be regarded as a significant environmental contaminant. There are, however, very few well substantiated facts and many unknown factors relating to the effects of ^{14}C on the earth's population. The properties of ^{14}C are

such that incorporation in the genetic material is bound to occur, and the effects will come not only from ionization by its beta particle but also from transmutation within the genetic molecule. It is true that because of the long half-life of ^{14}C, the extent of damage to the present generation from man-made ^{14}C has probably been small compared to the effect of natural ^{14}C, but it is conceivable that over a long time period it may add to the genetic mutation rate. An accurate assessment of the hazard posed by addition of ^{14}C to the biosphere is an enormously complex matter because of the extreme complexity of such a biological system as the earth's population and its environment. Estimates based on calculations cannot consider all of the many variables, and extrapolations from simple systems to man are of questionable validity. The absence of detectable effects does not prove that no effect is occurring. It may indicate only that the present methods are not sufficiently sensitive to detect the effect. Carbon-14 because of its weak beta characteristics and weak recoil energies may be more efficient in inducing subtle viable mutations than other experimentally more obvious mutagenic agents. When carbon undergoes transmutation to nitrogen, the chemical structure of the DNA molecule is altered. It is precisely whether or not this type of atomic alteration is significant that is a matter for the most serious study. (22 references.) (auth)

22453 INTRAORAL AND INTRACRANIAL MAXIMUM DOSES WITH PANORAMA RADIOGRAPHY OF THE TEETH AND JAWS. Jung, Till; Lohmann, Theo (Univ., Bonn). Deut. Zahnaerztl. Z., 18: 802-11(1963). (In German).

When all of the teeth are x rayed with intraorally emplaced dental films, or panoramic radiographs of the teeth and jaws are taken, various irradiation doses are accumulated in the oral cavity and its adjacent surroundings. The maximum intraoral and intracranial doses typically produced by these methods were measured in 2000 tests. Using 15 single bite-exposures the total dose in the anterior portion of the oral cavity was from 1.36 to 1.51 R. At the same point after 11 bite-exposures the dose amounted to from 0.81 to 1.12 R. Using panoramic enlargement exposures without amplification foils a max dose from 1.2 to 1.8 R was measured at the gum mucosa, and 0.9 to 1.3 R at the posterior portion of the tongue. When foils were used the doses were reduced to about $\frac{1}{8}$ of these values. The max dose for bite-exposure could be measured only in a few cases because the foils used shielded out considerable radiation. In each of the procedures the max dose value was found in a different tissue area. The oral mucosa was irradiated most with bite and panoramic exposures, while with panorama layer procedures soft tissues and the bones in the ascending portion of the mandible and in the area of the wisdom teeth in the upper jaw were irradiated the most. These differences were largely the result of differences in measurement locations. (BBB)

22454 PROBLEMS POSED BY NUCLEAR SUBMARINE NAVIGATION. Bouquet, E. Lyon Pharm., 14: 145-61(Mar. 1965). (In French).

Health hazards related to nuclear submarine operation and their control are reviewed, including problems of controlling radioactivity, purification of air, human expiratory substances, and accidental contamination. The sealed nuclear power generating unit largely eliminates possibility of contamination of the vessel by released radionuclides. In fact, control of reactor materials is so effective that the background activity in the vessel is usually lower than on the earth's surface. The crew, while submerged, receives less exposure to cosmic rays than does the terrestrial population, which may act to offset, at least in part, any radiation exposure in the course of their duties. Each member of the crew carries a device which will record accidental exposure if this should occur. Problems of maintaining the atmosphere in the submarine at healthy levels and removal of toxic products are also dealt with. Monitoring systems in the submarine are described. (BBB)

22455 AN X-RAY SIMULATOR AS A TREATMENT PLANNING MACHINE. Tavener, M. D. (Royal Marsden Hospital, Belmont, Eng.). Radiography, 32: 25-37(Feb. 1966).

A simulator for use with linear accelerators and ^{60}Co units is described, with data being given on protection of healthy tissue and prevention of personnel exposure with aid of the simulator. The isocenter couch, used with the simulator, simulates all the movements of the treatment couches, is motorized, and can be remotely and partly manually controlled. The operator, while completely protected from the x-ray beam, can screen and scan the patient in all directions, up and down, from side to side, and from head to foot. Techniques for special shielding by use of the machine are also considered. In treating an area which requires special shielding the simulator again makes this task easy. While checking all the treatment fields on the screen before taking a film for permanent record, the operator sees the surrounding structures of the body and can become aware of errors in planning and set-up which are not apparent from the plan or seeing the patient on the treatment couch. Two examples are cited to illustrate how sensitive structures can be shielded by use of this device. With the increasing energy of treatment beams, check films on the treatment machines become more difficult and in some cases impossible. With double-exposure techniques the dose to that part of the body which is outside the ultimate treatment volume becomes more of a problem. The simulator described allows a check of 90% of all fields planned, for making corrections under visual control, for producing a permanent record of the individual treatment, and for future treatment policy. (BBB)

22456 POSTGRADUATE TRAINING IN RADIATION PROTECTION. Schneider, Georg Heinrich. Roentgenpraxis, 17: 99-101(Apr. 1964). (In German).

This is a brief report of the 4th postgraduate meeting of the Association of German Radiation Protection Physicians in October 1963. The subjects reported on briefly consisted of recognition of radiation injuries, limits of film dosimetry, phosphate-glass dosimetry, international regulation of personnel dosimetry, the practical value of blood studies in radiation control, evaluation of blood studies in personnel radiation health, new methods for evaluation of blood studies, sensitivity of biochemical excretion studies, causes of radioinduced excretion of taurine, the role of β-aminoisobutyric acid and creatine in taurine excretion, evaluation of chromosomal changes in diagnosis of irradiation injury, radioinduced somatic mutations in vegetatively increased plant cultures, combination injuries resulting from irradiation and trauma, care, treatment, and healing of irradiation injuries, irradiation burden and burns, irradiation burden and infection, irradiation burden and humoral resistance, radiation burden and environmental effects, and burns and their treatment. (BBB)

22457 DISTRIBUTION OF STRAY RADIATION IN A RADIODIAGNOSIS ROOM. Fava, Giannino; Lattuada, Angelo (Univ., Milan). Tumori, 51: 351-60(Sept.-Oct. 1965). (In Italian).

Dosimeter readings were made at various positions around a fluoroscopy apparatus, used for gastrointestinal diagnosis, to estimate the extent of personnel exposure from scattered radiation. From the results of dosimetric evaluations it was possible to draw on the plan of the room the isoexposure curves for 200 to 0.5 mR/hr dose rates. The radiation emerging from the x-ray tube was not always reduced at a distance from the apparatus but on the contrary, sometimes increased. Indication of hot areas, which can be represented by paint on the floor of the room, is proposed as a means of warning personnel against remaining in certain areas when fluoroscopy is being performed. This simple precaution may be useful in preventing overexposure of personnel in radiological departments. (BBB)

22458 STUDIES AT THE TOTAL BODY COUNTER FOLLOWING THORIUM-X TREATMENT OF SKIN DISEASES. Born, W.; Oberhausen, E. (Univ., Freiburg i B.). Hautarzt, 16: 388-91 (Sept. 1965). (In German).

Five patients who had been treated with ThX (^{224}Ra) 1 to 6 yr previously for dermatological complaints were measured with a whole-body counter for possible deposits of long-lived γ-emitting decay products of ThX. In the patients studied no energies greater than those from ^{40}K were detected, indicating that no ThX was present. The ^{40}K content was within normal limits, as based on the isotopic fraction of the normal K present. Concentrations of ^{137}Cs ranged from 286 to 373 pC/g K. The results indicated that not only was there no evidence of Th present, but also there was no indication of any other γ emitters which may have been associated as impurities with the Th used for dermatological treatment. The use of the whole-body counter for studies of this type adds considerably to the knowledge available about the effective danger to persons exposed to certain specific radioactive materials. (BBB)

22459 RADIATION EXPOSURE AND RADIATION PROTECTION IN TOOTH, MOUTH, AND JAW THERAPY. Sonnabend, Eberhard (Univ., Goettingen, Ger.). Radiologe, 6: 320-3 (Aug. 1966). (In German).

Protection of personnel occupationally exposed to radiation, including the physician, dentist, technician, and patient is discussed. The doctor or dentist should stand at least 2 m away from and behind the x-ray tube while exposures are made. If necessary, Pb rubber aprons should be worn. X-ray film should be held in the patient's mouth by the patient, and not by professional or technical personnel. X-ray equipment should be situated as far apart from other working spaces as possible. Fluoroscopy need not be used in dental practice. Exposure of dental patients varies with the type of x ray photograph and the point of measurement. At the skin surface, a single dental photograph results in 0.5 to 2.7 R. The gonadal dose is ~0.5 mR. The gonadal dose is ~4 to 6 mR when a full set

of 11 photographs is taken. These yield ~5 R, measured at the skin surface of the chin. Exposure time should be kept at a min, using the most sensitive film possible. The size of the field irradiated should also be kept as small as is practicable, and the x-ray beam should be directed as far away from the gonads as possible. Highly filtered radiation reduces the skin dose, and if the focus-skin distance is large, the skin dose can be reduced by as much as 40%. (BBB)

22460 SHIELD FOR THE PROTECTION OF THE TESTES OF PERSONNEL OCCUPATIONALLY EXPOSED TO IONIZING RADIATION. Petrovcic, F. (Novosel General Hospital, Zagreb). Arhiv Hig. Rada Toksikol., 17: 317-22(1966). (In Croatian).

A shield for the protection of the testes of personnel exposed to the action of ionizing radiation has been devised and used since 1942. It is believed to be the first device for the direct protection of the gonads from radiation proposed so far. The protective device consists of a lead shield 1 mm thick that is suitably shaped and folded. The lead shield is lined with cloth. Instead of the shield of metallic lead, a layer of lead rubber exerting an equal protective action can be used. Tests showed that wearing devices of this type in addition to protective aprons provides effective protection of personnel working with X-ray sources emitting radiation of an intensity up to 150 to 200 kV. (JPRS)

22461 THE UPTAKE AND RETENTION OF ^{32}P AND ^{65}Zn FROM THE CONSUMPTION OF COLUMBIA RIVER FISH. Honstead, John F.; Brady, David N. (Battelle-Northwest, Richland, Wash.). Contract AT(45-1)-1830. Health Phys., 13: 455-63 (May 1967).

Seven volunteer subjects participated in a study of the uptake and retention of ^{32}P and ^{65}Zn as a result of eating Columbia River fish. Analysis of the fish provided ingestion data, while whole-body counting techniques established the resulting body burdens. A beta counter calibrated for ^{32}P body burden measured the retention of this radionuclide. In addition, excreta and blood samples were collected and analyzed to evaluate uptake and transfer parameters. The experiment provided new estimates of the fractional uptake of radio-phosphorus (100 per cent) and radio-zinc (35 per cent) from fish, as well as the effective half-lives. As a result of utilizing several subjects in the experiment, a measure of the possible variation of the value of these parameters among members of the population is provided. (auth)

22462 AGRICULTURAL IMPLICATIONS OF A RELEASE OF FISSION PRODUCTS FROM A CRITICALITY INCIDENT. Garner, R. J.; Morley, F. (United Kingdom Atomic Energy Authority, Harwell, Eng.). Health Phys., 13: 465-75(May 1967).

The consequences were assessed, in relation to human consumers of agricultural products, of a release of fission products from criticality excursions of magnitude 3×10^{18} to 10^{20} fissions in metal and liquid systems. It is concluded that exposure of children through ingestion of contaminated milk is unlikely to be a serious problem with excursions of magnitude less than 10^{20} fissions unless a substantial fraction of the fission product inventory is released to the environment. Other agricultural products are likely to be of little significance. For an excursion of 10^{20} fissions in a metal system, assuming vaporization and complete release of fission products, it might prove necessary to ban the consumption of milk within a radius of 10 km of the release if the emergency action reference level currently accepted in the UK of 25 rad to the thyroid gland is not to be exceeded. (auth)

22463 THE ASSESSMENT OF THE PRINCIPAL PUBLIC RADIATION EXPOSURE FROM, AND THE RESULTING CONTROL OF, DISCHARGES OF AQUEOUS RADIOACTIVE WASTE FROM THE UNITED KINGDOM ATOMIC ENERGY AUTHORITY FACTORY AT WINDSCALE, CUMBERLAND. Preston, A.; Jefferies, D. F. (Ministry of Agriculture, Fisheries, and Food, Lowestoft, Eng.). Health Phys., 13: 477-85(May 1967).

The discharge of aqueous radioactive effluent to the sea from the United Kingdom Atomic Energy Authority's Windscale factory is limited by the contamination of Porphyra seaweed used for the manufacture of the foodstuff laverbread in South Wales. Data gathered for the estimation of the radiation dose received by consumers of this food, and estimates of the annual dose to the gastrointestinal tract of adult consumers eating at the highest observed rate, are presented for the years since 1959. In particular, the production, distribution and consumption of laverbread are discussed in relation to the interpretation of radioassay results from the seaweed raw material collected in the vicinity of the Windscale discharge point. (auth)

22464 GENERALIZATION OF HOLLAND'S METHOD TO ASSESS GAMMA-DOSES FROM RADIOACTIVE CLOUDS. Alonso, A. (Junta de Energia Nuclear, Madrid). Health Phys., 13: 487-94(May 1967).

A method to assess whole-body γ-doses from radioactive clouds is presented. The calculations are carried out by means of simple nomograms which yield a geometry correction factor to be applied to the infinite cloud model. The procedure is based on a generalization of Holland's solution to include non-isotropic Gaussian clouds. The method is capable of rendering accurate values without using elaborate digital codes, and it is a useful tool for a rapid evaluation of whole-body γ-doses from clouds of reactor debris. (auth)

22465 CHARACTERISTICS OF NATURAL RADIOACTIVITY OF LEAVES OF TREES AND BUSHES GROWING IN SOME BOTANICAL GARDENS OF THE EUROPEAN PART OF THE USSR. Alfimov, N. N.; Yagovoi, P. N.; Tikhomirov, V. P. (Military-Medical Academy, Leningrad). Radiobiologiya, 6: 601-4(1966). (In Russian).

Data on the natural radioactivity of the leaves of trees and bushes was determined by measurement of the K concentration of the leaves and calculations of the β activities produced by ^{40}K in Ci/kg of air dried materials. The activity caused by the ^{40}K accounts for 33 to 66% of the total activity. Residual activity was connected with the presence in the leaves of other radioisotopes. (J.S.R.)

22466 OBLIQUITY PROBLEMS IN TELECESIUMTHERAPY. Debois, J. M. (Univ. St. Rafael, Leuven, Belg.). J. Belge Radiol., 49: 268-73(1966).

Comparison has been made between theoretical corrections and experimentally obtained isodose curves for obliquely incident telecesium beams. The discrepancies are outlined. The method which gives the best results is the half-way shift procedure. The telecesium apparatus is a Barazzetti Cesapan unit with 1,800 Ci and diameter 3.6 cm. An automatic isodose plotter and Philips ionization chamber (3 ml) were used with a 50 × 50 cm water phantom 75 cm deep. (R.E.U.)

22467 ROLE OF THE DOCTOR APPROVED FOR THE SURVEILLANCE OF WORKERS EXPOSED TO IONIZING RADIATIONS. Demulder, R. (MBLE, Brussels). J. Belge. Radiol., 49: 274-80(1966). (In French).

The medical supervision of workers exposed to ionizing radiation is discussed, not so much according to national or supranational regulations as pursuant to the experience of the factory doctor. The manner in which the medical authority fits every facet of the concern is discussed. Particulars are stressed regarding this professional hazard, periodical examinations, and tracking possible radioactive contaminations. (TSS)

22468 PROBLEM OF RADIOPROTECTIVE ACTION OF PYROGENS. Kalinina, N. A. (Inst. of Experimental Medicine, Leningrad). Radiobiologiya, 6: 580-2(1966). (In Russian).

The radioprotective effect of the vaccine B. mesentericus under different conditions of administration was investigated in white rats exposed to x ray doses of 800 and 500, 600, and 800 R. The results showed that B. mesentericus can have a radioprotective effect when it is injected three days before irradiation. Single injection of the vaccine before irradiation and its injection after irradiation does not have a favorable effect on the radiation sickness. (J.S.R.)

22469 UMWELTRADIOAKTIVITAET UND STRAHLENBELASTUNG. Bericht II/66. (Environmental Radioactivity and Radiation Burden. Second Quarterly Report, 66). Bad Godesberg, Ger., Bundesminister fuer Wissenschaftliche Forschung, 1966. 234p. DM 12.-.

The content of the radioactive materials in air, water, soil, and food materials and the radiation burden of the population in the German Federal Republic measured during the second quarter of 1966 are reported in graphic and tabular form. (J.S.R.)

22470 STRONTIUM RETENTION AS A FUNCTION OF AGE IN THE DOG. Anderson, John Joseph Baxter. Ithaca, N. Y., Cornell Univ., 1966. 97p.

Thesis.

Data are given on bone turnover in the dog as related to initial retention and loss of alkaline earths and especially to determine the effect of age on the retention of a singly-injected dose of radiostrontium in purebred beagles. It was also planned on the basis of comparative physiology to extrapolate the conclusions reached in the dog to the human, and thus, to arrive at a better understanding of the most susceptible age or ages of greatest potential biological damage from strontium-90 in nuclear fallout. (TSS)

Medicine

Refer also to abstracts 22305, 22326, 22437, 22439–22442, 22445, 22446, 22448, 22449, 22466, 22655, 22673, 22716, 22718, 22723, and 22726.

22471 (ACRH–26) SEMIANNUAL REPORT TO THE ATOMIC ENERGY COMMISSION. Jacobson, Leon O. (ed.) (Argonne Cancer Research Hospital, Chicago, Ill.). Sept. 1966. Contract AT(11-1)-69. 135p. Dep. mn. CFSTI $3.00 cy, $0.65 mn.

Separate abstracts were prepared on fifteen sections of this report. A list is included of twenty-eight publications during the period covered. (C.H.)

For abstracts of individual sections see: 22226–22231, 22373, 22374, 22472–22475, 22648, 23784, and 23785.

22472 (ACRH–26, pp 52-6) THREE-DIMENSIONAL IMAGE RECONSTRUCTION IN SCANNING AND RADIOGRAPHY. Harper, P. V. (Argonne Cancer Research Hospital, Chicago, Ill.).

The use of the Anger scintillation camera and the ^{99}Mo-^{99}Tc generator for scintillation scanning for the diagnosis of a variety of conditions is discussed. It is pointed out that the ^{99}Tc pertechnetate eluted from the generator emits a clean 140 keV γ with a 6 hr half-life that makes it ideal for use for scanning while resulting in a trivial radiation dose to the patient, and that its biological properties make it useful as an extracellular fluid tag in brain tumor scanning, its ionic properties make it a good thyroid scanning agent, and its chemical flexibility makes it usable as a liver, spleen, kidney, bone marrow, and placenta scanning agent. The 140 keV γ is easily collimated and almost all the energy is photoelectrically absorbed in the thin scintillation crystal of the camera, giving good imaging properties. The possibility of using the combination of a γ camera and ^{99}Tc for full three-dimensional mapping of isotope distribution by performing section scans at successive levels is discussed. (C.H.)

22473 (ACRH–26, pp 57-64) IMAGING TECHNETIUM-99m COMPOUNDS WITH THE GAMMA SCINTILLATION CAMERA, AND THE USE OF THIS SYSTEM TO AVOID THE DISTORTION OF RESPIRATORY MOTION IN RADIOISOTOPE SCINTIPHOTOGRAPHY. Gottschalk, A.; Jiminez, F. F.; Lu, C.-t.; Beck, R. N.; Harper, P. V. (Argonne Cancer Research Hospital, Chicago, Ill.).

The use of ^{99}Tc compounds with a γ scintillation camera for radiodiagnosis is discussed. It is pointed out that a wide variety of examinations can be made with the numerous forms of ^{99}Tc available, such as sulfur colloid, iron complex, albumin, macroaggregated albumin, and injected or inhaled pertechnetate. Although conventional scanning equipment may be used with ^{99}Tc, the counting takes more time than when a γ camera is used. The use of the system for a variety of examinations is illustrated. A procedure is described that avoids the distortion of respiratory motion during radioisotope scintiphotography. (C.H.)

22474 (ACRH–26, pp 115-18) MODIFICATION OF RADIATION RESPONSE OF TISSUE BY ACTINOMYCIN: PRELIMINARY CLINICAL EVALUATION. Griem, M. L.; Ranninger, K. (Argonne Cancer Research Hospital, Chicago, Ill.).

Patients with a variety of advanced neoplasms were given intravenous injections of 0.5 mg of actinomycin D followed after 3 to 4 hr by a 500 rad minimum dose of x radiation to the tumor, with this sequence repeated twice weekly for 2 to 4 weeks until a total radiation dose of 2,000 to 4,000 rads was reached. Results are summarized on 42 cases evaluated after treatment. An increase in the radiosensitivity of tumors was observed in 23 cases, with the response of 10 cases not clearly defined, and no response to any treatment observed in 9 cases. The difficulty in determining whether the joint action of actinomycin and radiation is additive or whether there is a true therapeutic synergism resulting in an enhanced response in the irradiated tumor compared to the response in the normal tissues of the host is discussed. Possible explanations for the response of tumors to the combined treatment are considered. (C.H.)

22475 (ACRH–26, pp 119-21) MODIFICATION OF RADIATION RESPONSE OF TISSUE BY COLCHICINE: A CLINICAL EVALUATION. Griem, M. L.; Malkinson, F. D. (Argonne Cancer Research Hospital, Chicago, Ill.).

A group of 138 patients with advanced neoplasms that were considered inoperable and unsuited for routine palliative radiotherapy were given 4 to 5 mg of calchicine intravenously followed by a minimum dose of 500 rad x radiation delivered to the tumor and repeated every 4 or 5 days until a total tumor dose of 4,000 rads was reached. Results are summarized and data are presented on the histology and location of the lesions. An impressive response was observed in some patients and several patients were alive more than 3 yr after treatment. (C.H.)

22476 (AD–638969) THE IMPACT OF CIVIL DEFENSE INFORMATION. I. AN EXAMINATION OF INFORMATION LEVELS. Rosenberg, Dorothy B. (Pittsburgh Univ., Pa. Dept. of Sociology). June 1966. Contract OCD-OS-63-48. 101p. CFSTI $3.00 cy, $0.65 mn.

The impact of Civil Defense information was studied in terms of levels of information about CD, cold war, effect of nuclear weapons, and arms control and disarmament efforts. Subjective levels of information on these four issues, based on a national block sample's self-imputed information, are compared with objective levels of information determined by other researchers, and these two measures of information levels are found to be compatible. While there is no way of knowing whether information people think they have is accurate, those who tend to feel they are informed about CD are women as well as men, Negroes as well as non-Negroes, those at all but the lowest level of education, those at all levels of income. The most important personal factors are related to respondent's age. Those who have high subjective CD information display a greater optimism about the future and are less inclined to want World War III or a Communist surrender because of U. S. technological supremacy; they favor all shelter programs and tend to feel that the present warning system is very good. The findings imply that there is little need to try to convince the American people that CD measures are desirable or warranted; and that CD messages can afford complete frankness in depicting to the nation both the promise and the limitations of protective measures. (CFSTI)

22477 (BNL–994, pp 124-39) MEDICAL RESEARCH. (Brookhaven National Lab., Upton, N. Y.).

The report provides brief summaries in the areas of effects of radiation: medical studies of Marshall Islanders accidentally exposed to radioactive fallout in 1954, response of the skin of swine to increasing single doses of ionizing radiations, lens opacification in the mouse, and kinetics of growth of spleen nodules in irradiated mice — anomalous decrease in number with time post-irradiation; clinical and metabolic studies: clinical studies with extracorporeal irradiation of blood, mechanism of salt-induced hypertension, vitamin B_6 as related to quinolinic acid production in man, melanin metabolism in Parkinsonism, kinetics of calcium and strontium metabolism, studies with radioisotopic carbon and hydrogen of disorders of intermediary metabolism of carbohydrates and fats, clinical use of technetium-99m as a scanning agent, and computer applications to medical research; nucleic acid structure and function: factors affecting the stability of the double helix of DNA, preparation and structural analysis of mammalian RNA's, radionucleoside incorporation by thymidine-synchronized cells, the effect of ionizing radiation on cell survival and compensatory enlargement of the kidney; antigens and antibodies: lymphocyte transformation, cytokinetics of lymphoreticular tissue during the secondary antibody response, immune response of lymphocyte-depleted animals, and immunological mechanism studies with extracorporeal irradiation of lymph; protein structure and function: synthesis of insulin and its analogues, hydroxylysine formation and collagen synthesis in scurvy, mechanisms controlling membrane permeability and transport processes at the cellular and molecular levels, and bioenergetic mechanisms involving free radicals. (B.H.S.)

22478 (N–66-32408) PREVENTION OF THE BONE MARROW SYNDROME IN IRRADIATED MICE. A COMPARISON OF THE RESULTS AFTER BONE MARROW SHIELDING AND BONE MARROW INOCULATION. de Vries, F. A. J.; Vos, O. (Rijksverdedigingsorganisatie TNO, Rijswijk (Netherlands). Medisch Biologisch Laboratorium). Apr. 1966. 19p. (MBL–1966-3; TDCK–45628). CFSTI $3.00 cy, $0.65 mn.

Shielding of bone marrow in irradiated mice was compared with intravenous injection of a bone marrow cell suspension in its effectiveness to prevent a bone marrow syndrome. Three criteria were used to measure this effectiveness: (a) survival of the irradiated mouse at 30 days after irradiation; (b) repopulation of irradiated haematopoietic tissues; and (c) incidence of spleen colonies. On the basis of the number of cells involved bone marrow injection appeared to be at least 100 times more effective than bone marrow shielding. (auth)

22479 (NYO–2181-4) EPIDEMIOLOGICAL FOLLOW-UP OF THE NEW JERSEY RADIUM CASES. I. REPORT OF THE EPIDEMIOLOGICAL AND MEDICAL STUDY GROUP AND THE PROJECT SUBCONTRACTORS. II. RESUME OF COOPERATIVE LABORATORY STUDIES ON PROJECT CASES AND SPECIMENS. III. RESUMES OF FINDINGS FROM INDIVIDUAL CASE STUDIES. Progress Report to October 1, 1966. (New Jersey State Dept. of Health, West Orange. Radium Research Project). Mar. 1967. Contract AT(30-1)-2181. 128p. Dep. mn. CFSTI $3.00 cy, $0.65 mn.

A summary is presented of data from clinical, laboratory, and statistical studies on a group of radium dial pointers and other radium workers exposed to ^{226}Ra or ^{228}Ra more than 40 years ago. Findings are included on 15 new cases exposed to ^{228}Ra. (C.H.)

22480 (NYO–2192-9) AN INVESTIGATION INTO THE PROPERTIES OF ANTI-IRRADIATION DRUGS. Progress Report. DiStefano, Victor (Rochester Univ., N. Y.). Feb. 9, 1967. Contract AT(30-1)-2192. 12p. Dep. mn. CFSTI $3.00 cy, $0.65 mn.

The pharmacological properties of several chemical radioprotective compounds were investigated in laboratory animals. Results are reported from studies on the pharmacological effects aminoethylisothiourea hydrobromide (AET), mercaptoethylguanidine (MEG), cystamine, and dimethylsulfoxide (DMSO) in cats and mice. Data from previous studies in dogs, guinea pigs, rabbits, and rats are summarized. An attempt was made to determine the mechanism of toxicity of the compounds and to relate radioprotective properties to pharmacological effects. The pharmacological properties of the compounds were found to differ in mice and cats, offering little possibility of correlation with radioprotective effects. (C.H.)

22481 (ORNL-TM-1693(Pt.5)) A SYSTEM FOR BIOMEDICAL DATA MANAGEMENT (DATASYS). PART V. BIORPG. Smith, Diana B. (Oak Ridge National Lab, Tenn.). Jan. 1967. Contract W-7405-eng-26. 18p. Dep. mn. CFSTI $3.00 cy, $0.65 mn.

BIORPG allows the user to generate reports directly from data files. Headings, footings, spacing, and the lines per page may be designated by control statements. BIORPG can be used conveniently with other DATASYS modules to list selective data in almost any prescribed format. (auth)

22482 (CONF-660412-8) TREATMENT OF CUTANEOUS RADIO-LESIONS. Simon, S. Translated by W. K. Dunscombe (Atomic Energy Research Establishment, Harwell, Eng.), from paper Presented at Symposium on Accidental Irradiation at Place of Work, Nice. 12p. Dep. mn. CFSTI $3.00 cy, $0.65 mn, JCL $1.60 fs, $0.80 mf.

The pathology and treatment of accidental radioinduced skin lesions are discussed. The anatomical structure of the skin is reviewed and it is pointed out that skin is a very radiosensitive tissue. The extent of radioinduced lesions depends on the quantity of ionizing energy absorbed in the different cutaneous strata. Exposure to 600 R x radiation produces erythema and epilation, 800 R causes radiodermatitis, and doses of 1000 to 1500 R cause radionecrosis, while exposure to larger doses, particularly of the hands, may result in osteitis. The treatment of radioinduced skin lesions consists of conservative therapy that permits evaluation of the extent of the lesion and makes the most of the possibility of spontaneous healing. Local infection should be prevented and dressings that may adhere to the wound should be avoided. Ointments containing cod liver oil, vitamins, or cortisone may promote healing. The use of ointment containing padutin (kallikrein), a pancreatic extract that does not contain insulin, promoted healing in experimental animals and in some patients. It is pointed out that it is essential to avoid sclerosis and vascular disorders, since prognosis will depend on the state of the blood vessels. Surgical procedures should be delayed until all other treatments have failed. The patient should be warned of the possibility of cancer developing throughout his life and told of the need for periodic examinations. (C.H.)

22483 EFFECT OF RADIOPROTECTIVE COMPOUNDS SUCH AS β-AMINOETHYLISOTHIOURONIUM (AET) AND MERCAPTOETHYLGUANIDINE (MEG) ON THE THYROID GLAND OF HETEROPNEUSTES FOSSILIS BLOCH. Kapoor, Anoop Saran (Univ. of Rajasthan, Jaipur, India). Strahlentherapie, 132: 472-6(Mar. 1967).

Heteropneustes fossilis Bloch, an Indian catfish, were treated with AET, MEG, Eltroxin (Glaxo: synthetic thyroid hormone), and thiourea. A fortnight's thiourea treatment did not bring about significant hypothyroidism. After treatment with Eltroxin, the size of the thyroid follicles was greatly reduced, the ratio of colloid and follicular area remaining the same as in control. MEG brought about a highly significant hypothyroidism as judged by histological pictures as well as radioiodine uptake. AET failed to evoke any change in the thyroid follicles. It is concluded that one of the factors of MEG acting as a radioprotective drug may be that it induces hypothyroidism in animals. (auth)

22484 DEPTH-DOSE CALCULATION FOR THE ^{60}Co-EYE APPLICATOR CKA1-4 (BY STALLARD). Magnus, Lothar (Univ., Muenster, Ger.). Strahlentherapie, 132: 379-86(Mar. 1967). (In German).

Radiation dose rates for different tissue depths can be obtained by formulas which are given for the ^{60}Co-eye-applicators by Stallard (CKA 1-4). The results obtained are tabulated. (auth)

22485 LYMPHOCYTE SURVIVAL IN MEN TREATED WITH X-RAYS FOR ANKYLOSING SPONDYLITIS. Buckton, Karin E.; Court Brown, W. M.; Smith, P. G. (Western General Hospital, Edinburgh). Nature, 214: 470-3(Apr. 29, 1967).

Lymphocytes with radiation-induced chromosome aberrations, examined in patients treated with x rays for ankylosing spondylitis, are estimated to have a mean life span of about 1,600 days. (auth)

22486 MORPHOLOGICAL CHANGES IN RADIOPROTECTED, LETHALLY IRRADIATED, AND BONE-MARROW TREATED ANIMALS. Dimitrov, L.; Krustev, D. (Research Inst. of Hematology and Blood Transfusion, Sofia). Compt. Rend. Acad. Bulg. Sci., 20: 77-80(1967).

Experiments were performed with albino rats irradiated with 800 R and treated with prophylatic agents (AET, MEA, and 5-hydroxytryptamine) and therapeutic agents (bone marrow, antibiotics, and vitamins). Mortality was 100% in the unprotected group at 7.6 days, whereas lethality in animals receiving the full complement of prophylactic and therapeutic agents was 24.6% at three months. Morphological changes were observed in bone marrow, spleen, intestines, liver, lungs, kidneys, and gonads. It was evident that prophylactic and therapeutic treatments do not fully avert radiation injuries, particularly in the more radiosensitive tissues. Survival of the acute stage of radiation sickness in protected animals was attributed to protection of hematopoietic function and the gastrointestinal tract. Although initial response to pathological processes was enhanced by radioprotective treatments, later appearance of inflammations was believed to be caused by atrophy of the lymph apparatus. (H.G.D.)

22487 EFFECT OF CERTAIN RADIOPROTECTORS ON THE IMMUNE REACTION OF LETHALLY IRRADIATED RATS. Dimitrov, L.; Nedyalkova, M. (Research Inst. of Hematology and Blood Transfusion, Sofia). Compt. Rend. Acad. Bulg. Sci., 20: 73-6(1967).

The effects of mixtures of AET, MEA, and 5-hydroxytryptamine on immune reactions in lethally irradiated rats and in animals that had survived lethal irradiation were studied. Irradiated controls survived at average of 7.6 days postirradiation. Lethality rates were considerably lower in the protected animals, and those in which radioprotection was effective began to recover clinically and hematologically. In irradiated control rats immunized 24 hrs postirradiation with sheep erythrocytes, the number of hemolysin-producing cells in the spleen did not increase significantly, and no hemagglutinating antibodies were found in the serum. However, hemolysin-producing cells were considerably more numerous in the spleens of radioprotected animals. Changes in serum hemolysins in this group were similar. Rats that survived lethal doses for 5 to 6 months were found to have normal numbers of hemolysin-producing cells in the spleen as well as normal titers of serum hemolysins. Irradiated rats that survived for more than one year showed immune reactions directly dependent upon their general condition. Antigens injected 24 hrs postirradiation into radioprotected animals demonstrated the presence of immunologically-competent spleen cells. It is further concluded that the radioprotective mixtures had no clearly-definable effect on the synthesis of hemagglutinating antibodies. (H.G.D.)

22488 MEASUREMENT OF STANDARD ION DOSE IN SOLID AND LIQUID MEDIA FOR X RAYS AND GAMMA RAYS WITH ENERGIES BETWEEN 50 keV AND 3 MeV. III. STUDIES ON RELATION BETWEEN SENSITIVITY OF IONIZATION CHAMBERS AND INCIDENT RADIATION DIRECTION FOR MEASUREMENTS IN SOLID AND LIQUID MEDIA. Will, Wolfram; Rakow, Adalbert (Inst. fuer Biophysik, Berlin). Strahlentherapie, 132: 387-98 (Mar. 1967). (In German).

The relation between the sensitivity of different ionization chambers and the incident radiation direction was determined for 120- and 200-kV x rays and ^{60}Co gamma rays in air and in a water phantom. The angular distribution results obtained in the phantom were different from those obtained in air. The angular distribution for the phantom, which depends only to a small degree on the irradiation conditions considered, can cause errors in the determination of the standard ion dose in the phantom since the calibration is related to a special incident direction free in air. (auth)

22489 CLINICAL IMPORTANCE OF THE PROFILE SCANNING. Karika, Zsigmond; Tarjan, Gyorgy; Fuzy, Marton. Magyar Radiol., 18: 361-4(Dec. 1966). (In Hungarian).

On the basis of their material, the clinical possibilities of profile-scintigraphy are outlined. The present scintigrams have obtained using the isotopes I-131, Au-198, Cr-51 and Fe-59. This method is suitable for the study of the distribution, transport and elimination of the gamma-radiating isotopes ingested into the organism. Using a phantom with known activity, the isotope content of the organism may be determined. (tr-auth)

22490 ROLE OF THE REDUCTION OF THE MINUTE-DOSE AND OF THE GRID METHOD IN THE RADIATION THERAPY. Hernady, Tibor; Kenez, Jozsef. Magyar Radiol., 18: 348-56 (Dec. 1966). (In Hungarian).

On the basis of the experiments reported in the literature it is pointed out that in the orthovolt X-ray therapy besides the fractional method, the reduction of the minute-dose does come in to play because the low dose performance necessary for the increase

of the electivity of the ray effect is practically unrealizable. The theoretical and practical problems in connection with the grid irradiation are discussed and the importance of this method emphasized. (auth)

22491 RADIUM REVISITED: A RETURN TO FUNDAMENTALS IN OVERCOMING PROBLEMS OF MALPOSITION AND EXPOSURE. Scott, W. P. (Charlotte Memorial Hospital, N. C.). S. Med. J., 59: 1304-12(Nov. 1966).

Improved technics are described which assure correct positioning of intrauterine Ra sources, preventing injury to healthy tissue. Also, means for reducing exposure to personnel dealing with Ra-implanted patients are described. The influence of malposition of Ra implants on radiocurability and complications is emphasized. Malalignment, which is radiographically demonstrated in the sagittal plane and frequently overlooked or underestimated, contributes most heavily to the complications and failures encountered. The alignment applicator described, which can be used interchangeably with the Paris colpostats and Manchester ovoids, affords the best application of Ra under the worst circumstances. The elimination of malposition also eliminates unnecessary radiation exposure incurred in removing, reapplying, and repacking the Ra system. Ways and means of reducing the radiation exposure to hospital personnel by a rapid but simplified method of handling the Ra is described. Even if elaborate Ra services are not available, radiation exposure can still be minimized by simplifying procedure to take advantage of the 2 safety factors speed and distance. The alignment applicator will not only facilitate these factors but will also ensure against a poor application which would necessitate correction or reapplication and hence further exposure to all concerned. The total time of radium handling to surgeon and technician should rarely exceed 3 min for each, while the exposure to the operating room personnel and nursing personnel remains negligible. (BBB)

22492 TREATMENT OF RECURRENT CARCINOMA IN SITU IN THE LOWER GENITAL CANAL. Woodruff, J. Donald (Johns Hopkins Univ., Baltimore). Clin. Obstet. Gynecol., 8: 757-70 (Sept. 1965).

The use of radiotherapy and other forms of treatment for cervical carcinoma which has recurred after primary treatment is considered, along with the complications of such radiotherapy and the possibility that the recurrent tumor may have been radioinduced. Recurrent lesions at the apex of the vaginal vault may be treated by irradiation, radium being introduced into the vaginal fornices in the Manchester type of ovoid or directly against the apex in a single applicator. Adequate dosage consists of 7000 to 8000 R to the vaginal mucosa. Care should be taken to maintain an empty bladder and rectum during the course of therapy, and dosage to these areas should be measured by an intravesical or intrarectal scintillation probe. Adequate packing of the outer vault will aid in the prevention of radiation burns to the adjacent vulvar skin. Results are generally favorable, but possible complications of irradiation include: (1) the occurrence of anaplasia in other sites either in the vault or on adjacent vulvar skin, and (2) persistently abnormal vaginal cytologic and histologic findings. These results are illustrated by case reports. It is important to determine whether such persistent changes represent residual malignant change in the remaining epithelium associated with underlying invasive disease, recurrent anaplasia as the result of a continuing carcinogenic stimulus, a new lesion possibly a result of the radiation effect on the adjoining tissue, or merely postirradiation changes in the tissue (bizarre nuclear patterns, endothelial proliferation, nonviable tumor cells, or foreign body giant cell formation). (BBB)

22493 RADIOTHERAPY FOR CARCINOMA OF THE LARYNX. Charteris, A. A. (Western Infirmary, Glasgow). Scot. Med. J., 11: 99-100(Mar. 1966).

The effectiveness of interstitial Ra implantation, Ra teletherapy (with a 10-g Ra source), and x-ray treatment for laryngeal cancer is compared. In the use of a single-plane radium implant to the affected area, the thyroid cartilage was a problem since this avascular tissue would not tolerate high doses of radiation. But a new method was introduced by the cutting of a window in the cartilage, sited so that it would cover the affected area, hence the term fenestration method. The larynx was not opened, and needles were placed vertically at regular intervals, each inactive end being placed behind the upper and lower margins of the window and so held in position. Later, a Ra beam unit for telecurietherapy became available and the use of large amounts in a protected apparatus made it possible to produce a defined and measured beam which had a depth-dose in the tissue proportional to the distance of the source from the skin. The presence of cartilage in the field was no longer a problem, since it was not subjected to the high dose of radiation produced by Ra needles. The dose at certain depths below skin was such that 2 opposing fields had to be employed to reinforce each other. The x-ray method was mainly employed where the disease was too extensive to be included in the narrow beam from the Ra unit. The tendency was therefore to use x rays for more advanced cases or for palliative treatment. Clinical results, in terms of 5-yr cures, with the 3 methods are tabulated. (BBB)

22494 RADIATION EXPOSURE IN NUCLEAR MEDICINE. Boerner, Wilhelm (Univ., Wuerzburg, Ger.). Radiologe, 6: 323-7(Aug. 1966). (In German).

The most important factors that affect the irradiation dose from radioisotopes used in nuclear medicine are the physical half life value, the type and energy of the radiation emitted, the pattern of distribution and the rate of distribution in the various organs and organ systems, and the type and rate of excretion. The author compiled a table that lists the radiation dose received from several nuclear medical procedures. The nuclides included are ^{51}Cr, ^{131}I, ^{99m}Tc, ^{60}Co, ^{58}Co, ^{203}Hg, ^{197}Hg, ^{198}Au, ^{125}I, ^{132}I, and ^{75}Se. These radionuclides are considered according to their use in blood and circulation studied, scintigraphy of brain, liver spleen, kidney, and other organs, and details of radiation types and energies, and radiation dose in terms of mR for whole-body, gonads, and critical organs are given. (BBB)

22495 ANALYSIS OF THE RADIORENOGRAM TECHNIQUE. Walsh, E. L.; Murdock, H. R. Jr. (Veterans Administration Hospital, Huntington, W. Va.). Amer. J. Med. Sci., 252: 224-31(Aug. 1966).

Various methods of radioisotope renography are evaluated, and an improved method is presented that uses ^{131}I-labeled Miokon (diprotriozoate) and Hippuran (o-iodobenzoate). The method is reliable and reproducible, yet can be performed with fairly simple equipment and with a min expenditure of time. The test, which entails negligible hazard, can be used either for specific diagnostic purposes or else as a routine screening procedure for all hospitalized or out-clinic patients. The radioactive material was injected intravenously in the dose of 0.125 μCi/kg body weight (Miokon) or 0.05 μCi/kg (Hippuran). The average percentage urinary output of labeled Miokon and labeled Hippuran by subjects with normal kidney function is shown. The 20- and 90-min outputs of Miokon were 28% and 57% of the administered dose and for Hippuran 59% and 82% respectively. The output of Miokon was less than that for Hippuran, especially during the first 20 min. Normal kidney function is illustrated by a curve that peaked within 5 min and then dropped rapidly as the radioisotope flowed down to the bladder faster than it was being concentrated by the kidney. The record was continued for 20 min during which time the curve fell 60% from the peak height. In patients with advanced arteriosclerosis, the curve is low and flat, indicating poor circulation and concentrating ability. Similar curves are obtained in advanced glomerulonephritis or other conditions in which kidney function is poor. A lower dose of ^{131}I-labeled compound than is reported in the literature was used. Since the biological half life of the compound is very short, higher doses do not create a hazard, but just as satisfactory results can be obtained with the lower dose. The superiority of Hippuran over Miokon in the test was evident, and is emphasized by the need for the larger dose of Miokon. The amount of irradiation involved is not significant. (BBB)

22496 RADIOPHARMACEUTICALS. Wolf, Walter; Tubis, Manuel. J. Pharm. Sci., 56: 1-17(Jan. 1967).

A review with 256 references is given that includes a description of the properties of radioisotopes and of labeled drugs, methods of detection, clinical application, manufacture of radiopharmaceuticals, their use in radiation experiments, and radiosterilization of drugs. It is suggested that the most important recent advance in this field is more sensitive detection systems. Thus, newer, better, complex, and reliable instrumentation has been developed for the detection both of radionuclides in vitro and in vivo, especially because of notable developments in solid-state electronics. The ability of the AEC-sponsored National Laboratories (Brookhaven, Argonne, Oak Ridge) to produce any desired radionuclide, and of the nuclear industry to make these available at reasonable cost to investigators in the health sciences, has further widened the horizons of radiopharmaceuticals. The example of ^{99m}Tc, a radionuclide with a half-life of 6 hr, is indicative of the present trend toward radionuclides with a shorter half-life involving much less exposure of the patient to radiation. In vitro testing of biological functions such as the various methods available for protein-bound thyroid hormone, illustrates another trend: that of using radionuclides in the clinical lab without radiation exposure of the patient. A third major development is the use of ^{3}H- and ^{14}C-labeled biochemicals for measurement of specific metabolic disorders. Progress in β and γ irradiation

of pharmaceutical products (drugs, vitamin, plasma proteins, vaccines, and sutures) for low temperature sterilization is also examined. (BBB)

22497 IN VIVO PHARMACODYNAMIC EVALUATION OF ORAL DOSAGE FORMS BY WHOLE-BODY LIQUID SCINTILLOMETRY. Hecht, Gerald (Alcon Labs., Inc., Fort Worth); Christian, John E.; Banker, Gilbert S. J. Pharm. Sci., 55: 678-84(July 1966).

A model system was devised wherein a γ-emitting radionuclide (sodium ^{131}I-orthoiodohippurate was used for demonstration purposes) was administered intravenously and orally in various dosage forms, to study by whole-body liquid scintillometry the parameters of absorption, excretion, and intercompartmental clearance of radionuclides and the effect of variations in formula composition on these parameters. The γ-emitting test substance was administered intravenously, orally in aqueous solution, and orally in sustained and delayed-release dosage forms to unanesthetized female dogs, catheterized and fasted prior to dosing. Where applicable, plots of log per cent whole-body retention as a function of time were resolved into linear components following apparent first-order kinetics. The rate constants of these components were calculated and compared. Sustained-release forms were prepared which exhibited zero-order release characteristics in vitro and in vivo, and the characteristics of an enteric coated dosage form were compared after in vitro and in vivo testing. The procedure provided such parameters as absorption, excretion, release, and the effect of formulation techniques and formula variation on the biological availability of the test substance employed without the necessity of excreta and blood sampling and analysis. (BBB)

22498 POTENTIAL ANTIRADIATION DRUGS. II. 2-AMINO-1-ALKANETHIOLS, 1-AMINO-2-ALKANETHIOLS, 2-THIAZOLINES, AND 2-THIZAOLINE-2-THIOLS. Handrick, G. Richard; Atkinson, Edward R.; Granchelli, Felix E.; Bruni, Robert J. (Arthur D. Little, Inc., Cambridge, Mass.). J. Med. Chem., 8: 762-6(Nov. 1965).

Synthesis and radioprotective properties are described for 21 of these compounds. With few exceptions all compounds studied showed some protective activity in either mice or bacteria. The best protection was shown by 2-amino-1-pentanethiol, 2-amino-3-methyl-1-butanethiol, and 1-amino-2-propanethiol. Three thiazolines offering good protection were precursors of these aminothiols. Radioprotective activities observed were compared with those observed in other laboratories with the same or analogous compounds. In earlier work no significant relation was found between the radioprotective activity of certain aminothiol precursors and the ease of conversion to aminothiols in vitro. The failure of 22 thiazolines to protect rodents has been reported, but the present authors observed protective activity with 8 or 9 thiazolines studied. Evidence is presented that there may be a mechanism by which thiazoline is hydrolyzed in the mouse. The 2 thiazolinethiols tested (4-, and 5-methyl-2-thiazoline-2-thiol) provided no protection in rodents, a result noted earlier with 2-thiazoline-2-thiol. The results expected for these compounds are not only difficult to hydrolyze but also have very little thiol function, being primarily thiones. (BBB)

22499 THE TREATMENT OF RECURRENT CARCINOMA OF THE BLADDER BY SUPERVOLTAGE RADIOTHERAPY. Morrison, Robert; Deeley, Thomas J. (Hammersmith Hospital, London). Brit. J. Urol., 38: 319-22(June 1966).

With the introduction of supervoltage apparatus, such as telecobalt units and linear accelerators, the scope of radiotherapy for bladder cancer has widened and long-term results have now been obtained which compare favorably with surgical methods of treatment. Both surgery and radiotherapy, however, have limitations. In surgery, advanced tumors are technically difficult to remove; in radiotherapy, variation in radiosensitivity and tumor response makes the results unpredictable. Since it seemed likely that combined methods may have advantages over either method alone, 90 patients were treated by supervoltage radiation after surgery, when the tumor was known to have recurred. In the radiation techniques employed, the whole pelvis was irradiated and the fields extended to include any area where recurrence was likely to develop. No attempt was made to localize the fields of radiation to the tumor only. A tumor dose of 4500 rads was planned to be given in one month. Because of the previous surgery the tolerance of normal tissues was probably reduced and the tumor dose was limited to 4500 rads. This dose was well tolerated and it was not necessary to curtail treatment in any patient because of systemic upset and severe local reactions. Complications and late radiation effects are described. The anastomosis between the ureter and the colon is normally outside the field of irradiation and no difficulty was encountered here from radiation effects. (BBB)

22500 INSTRUMENTAL FACTORS AND THE MEASUREMENT OF PULMONARY FUNCTION WITH ^{133}Xe. Maloney, J. E. (Royal Postgraduate Medical School, London). Phys. Med. Biol., 12: 161-72(Apr. 1967).

The distribution of pulmonary blood flow and ventilation within the lung may be measured using ^{133}Xe. The recorded activity over the lung is a function of lung shape, spatial sensitivity of the detector, scattered radiation and, in scanning, the time constant and scanning speed of the recording apparatus. By a study of isolated lung models a method was developed to overcome the problems of scattered radiation and spatial sensitivity in the determination of the no-flow point, and it was found that for accurate recording the product of the time constant (sec) and scanning speed (cm/sec) should be less than 0.2. The level at which flow ceased was 1.3 (±1.7) cm above the point at which alveolar pressure equalled arterial pressure. In human subjects it is impossible to measure accurately the no-flow point due to the large detector field, scattered radiation and residual radiation in extra-thoracic tissue. Despite the fast scanning speed of 4 cm/sec for human subjects, it is suggested that an estimate of the mean linear rate of decrease in radioactivity in the lung could be obtained with a time constant of 0.2 sec. (auth)

22501 CLINICAL USE OF RADIOSTRONTIUM IN EVALUATION OF SPONDYLITIS. Fellaender, Mac (St. Goran's Hospital, Stockholm); Lindberg, Lars. J. Bone Joint Surg., 48A: 1585-1606 (Dec. 1966).

A new radioisotope technique employing ^{85}Sr was devised to investigate infectious spondylitis and was tested in a large series of patients. The method is based on the observation that Sr is deposited in the bone in the same way as Ca. In local skeletal lesions, such as in osteitis, fractures, and tumors, the rate of mineral metabolism in the area of the lesions is increased. Intravenously injected ^{85}Sr accumulates at the site of the lesion, with resultant increased radioactivity over the area involved. The patients were given 1 μCi of carrier-free ^{85}Sr/kg of body weight intravenously. The total dose was, however, never allowed to exceed 50 μCi. External counting was done 2 weeks later with the aid of a scintillation detector with a 2-in. crystal connected with a rate meter with a pulse height analyzer and a scaler. A 12° lead collimator was used. The increase in the ^{85}Sr uptake in the foci was calculated by subtracting the value of the calculated upper limit on the appropriate normal curve obtained for the vertebrae from the value over the lesion at the same point. The difference was called the peak value. Judging from the peak values noted, a value of more than 0.35 was taken as a definite sign of an active process unless the patient had recently been operated on. If the peak value was between 0.35 and 0, it was evaluated with caution. Both active and quiescent foci gave values in this range. The values over healing foci also passed through this range before they became normal. Also in this range were many cases difficult to judge clinically. If the uptake was normal, it was regarded as excluding the possibility of an active tuberculous focus. The isotope technique was not so useful in nontuberculous spondylitis. The uptake was highest during the acute stage and then decreased as healing progressed. It is concluded that the method is useful in the early diagnosis of clinically and roentgenographically dubious primary lesions and recurrences, but that the method cannot differentiate between tuberculous and septic spondylitis. (BBB)

22502 MANNITOL AUGMENTATION OF ^{131}I UPTAKE IN THE TREATMENT OF THYROID CARCINOMA. Hamburger, Joel I.; Desai, Prasanna (Wayne State Univ., Detroit). Metab., Clin. Exp., 15: 1055-8(Dec. 1966).

A method was devised for enhancing the uptake of ^{131}I by the thyroid gland 2- to 3-fold by induction of I diuresis with mannitol, thus augmenting the irradiation dose from ^{131}I in the treatment of thyroid carcinoma. Thyroid cancer has less avidity for ^{131}I than normal thyroid tissue, thus limiting the use of ^{131}I for inoperable thyroid malignancy. That iodide deficiency can increase ^{131}I uptake in normal thyroid tissue prompted an investigation of methods of iodide depletion in the preparation of thyroid cancer patients for ^{131}I therapy. Iodine-deficient diets alone, and the use of NaCl and mercurial diuresis, however, were unsuccessful. Seven patients with residual thyroid carcinoma after thyroidectomy were subjected to combined I-deficient diets and intravenous mannitol. This produced increases in 24 hr uptakes, in 5 of these patients, up to 34%. This augmentation in uptake was achieved without the stimulation of ^{131}I release that is produced by TSH. The use of intravenous mannitol is recommended as a valuable adjunct in the ^{131}I therapy of inoperable thyroid cancer. (BBB)

22503 PROBLEMS IN THE TRANSCUTANEOUS IRRADIATION OF THE PELVIC NEOPLASIA IN OBESE PATIENTS. Magno, Lorenzo (Istituto del Radio "O. Alberti," Brescia, Italy). Tumori, 52: 319-34(1966). (In Italian).

Problems in radioprotection of healthy tissues, dose distribution

calculations, and irradiation technique in treating obese women with uterine carcinoma are examined. When ^{60}Co is employed, obese patients may be irradiated by biaxial pendulum techniques, employing the same parameters (field at the axis, arc width, position of the axis) as in normal subjects. The shape of isodoses in pendulum axial irradiations with ^{60}Co does not depend on the dimensions of the body irradiated. The properties of high-voltage moving-beam radiotherapy are an advantage in obese patients. (BBB)

22504 CARDIAC SCANNING WITH ^{99m}Tc-LABELED ALBUMIN. Holmes, Richard A.; Silbiger, Martin L.; Karmen, Arthur; Wagner, Henry N. Jr.; Stern, Howard S. (Johns Hopkins Medical Institutions, Baltimore). J. Amer. Med. Ass., 198: 185-90 (Oct. 3, 1966).

Techniques for cardiac scanning with ^{99m}Tc-labeled human serum albumin were developed and evaluated in 56 patients. Technetium-99m, obtainable as a radioactive decay product of ^{99}Mo offers many advantages as a nuclide for scanning. The absence of β radiation with ^{99m}Tc and its 6-hr physical half-life, make it suitable for use in millicurie doses. When bound to serum albumin it can be effectively used to scan the cardiac blood pool with good resolution, and it was possible to define certain anatomical structures not previously visible on scanning images made using other isotopes as tracers. The patients were given intravenously 2 or 4 mCi of ^{99}Tc-labeled human serum albumin, and 5 to 10 min later were scanned from the front while lying supine. In selected patients it was possible to discern the ventricular musculature, specific chamber enlargement, and the interventricular septum. The superiority of ^{99m}Tc-labeled albumin to the pertechnetate ($^{99m}TcO_4^-$) was obvious in comparative studies and it is the agent of choice in blood pool scanning. (BBB)

22505 IRRADIATION AND OTOSCLEROSIS: HISTOLOGICAL STUDIES. Joergensen, M. Balslev; Kristensen, H. K. (Univ. Hospital, Copenhagen). Ann. Otol., Rhinol., Laryngol., 75: 677-86 (Sept. 1966).

Evidence was found that irradiation may induce a typical otosclerotic reaction in the labyrinthine capsule. Histological investigation of temporal bones from 165 patients showed a definite relation between x irradiation and otosclerosis. The case histories and histological findings in 4 patients are reported in detail. Case 1 had severe, active otosclerosis in a proliferative phase in both ears, immediately after a radiation dose of 3900 R to both ears. This patient was 70 years, an age at which active otosclerosis is rare. Case 2, who had received a dose of 2400 R to the right ear 11 months before death, showed otosclerosis only on the irradiated side. Case 3, with bilateral otosclerosis of moderate activity, had received 14 yr earlier a radiation dose of 1650 R, mainly to the left ear, but both labyrinthine capsules had evidently been irradiated. Why the focus on the left appeared to be older was perhaps on account of a higher radiation dose to this ear, which had reacted earlier. Case 4 had on the left side an otosclerotic focus of moderate activity, which occurred immediately after a radiation dose of 790 R to both ears. Thus, in Cases 1, 2 and 3 there was a definite relation between the side affected by otosclerosis, the activity of the focus, and previous radiotherapy. In Case 4 the relation was doubtful. In addition to these 4 patients, another 4 had received radiation of the skull for cerebral tumors, but in no case with the beam hitting the labyrinth. None of these 4 patients showed histological signs of otosclerosis. Thus, this investigation points consistently to a direct causative relation between irradiation and otosclerosis. As to the pathogenetic mechanism, 3 possibilities are suggested: a direct radiation-induced activation of dormant embryonic tissue, an accelerative effect upon a microscopic focus present already, or a process of repair in the labyrinthine capsule, caused by a radiation-induced aseptic necrosis of bone. (BBB)

22506 SUPERVOLTAGE ROENTGENOGRAPHY WITH LINEAR ACCELERATOR. Irwin, Gerald A. L.; Michaud, Normand J.; Zatzkin, Herbert R. (Meadowbrook Hospital, East Meadow, N. Y.). N. Y. State J. Med., 67: 414-17 (Feb. 1, 1967).

Use of a 6-MeV linear accelerator for radiotherapy of neoplasms, with simultaneous radiographic tumor localization, is discussed, with emphasis on advantages over conventional radiation sources and the radiation doses received by patients. Supervoltage radiation therapy with the linear accelerator resulted in precise portal localization which was enhanced by using the accelerator for roentgenographic purposes. The use of an accelerator for diagnostic roentgenographic purposes is possible because of the Compton effect, manifested when radiation interacts with tissue. With voltages under 100 kV, bone stops the greater proportion of radiation, and only a small amount reaches the film. With increased voltages, greater amounts of radiation are transmitted through the bone because of decreased absorption, and therefore greater amounts reach the film. Two exposures are usually made. For the first exposure, 4 rad is delivered at the point of maximum ionization, 100 cm from target, 1.5 cm below the surface of the skin. Then with collimator shutters opened wide, a second exposure of 4 rad is again made. This provides a diagnostic film with the treatment field shown as a darker area superimposed on the larger anatomic region. Precise portal localization is one of the greatest benefits to be gained from supervoltage radiation therapy with the linear accelerator. The technic of localization is enhanced by using the accelerator for roentgenographic purposes, thereby ensuring the inclusion of the area of concern within the treatment fields. The radiation exposure doses with the technics described are high in comparison to the usual doses used during routine diagnostic procedures, but the advantages of accurately localized treatment portals and the information gained from the diagnostic studies justify the increased radiation dose to cancer patients. (BBB)

22507 THE INTRALYMPHATIC ADMINISTRATION OF RADIOACTIVE ISOTOPES FOR TREATING MALIGNANT MELANOMA. Ariel, Irving M.; Resnick, Michael I.; Oropeza, Ruben (New York Medical Coll., N. Y.). Surg. Gynecol. Obstet., 124: 25-39 (Jan. 1967).

Tissue doses and histologic effects were determined of internal irradiation in the course of intralymphatic administration of radioisotopes in 28 patients with malignant melanoma. The 3 isotopes used were: ^{131}I-ethiodol, ^{198}Au as a submicron colloidal suspension and ^{90}Y as 1- to 4-μ diameter plastic micromicrospheres. In several patients, the dose of irradiation was calculated by performing counts on excised lymph nodes. The data for ^{131}I revealed a tremendous β radiation dose to the lymph nodes. The femoral lymph nodes received a calculated 45,500 rad dose, and the lowest dose after the administration of 20 mCi of ^{131}I-ethiodol was to the periaortic lymph node which received 12,220 rad. The γ dose was insignificant, and it probably did not contribute to the therapeutic effect. The effective half-life of ^{131}I-ethiodol was estimated to be 6 days. The ^{198}Au was used in several patients but it was not possible to obtain samples of lymph nodes to measure the effective dose in rads. External counting immediately after the administration of 25 mCi of ^{198}Au demonstrated a significant pickup in the lymph nodes and, to a lesser extent by the liver and the spleen; no activity was observed in the lungs. The lymphograms demonstrated that only active lymphoid tissue within a lymph node will concentrate the administered isotopes. Large cancer metastatic deposits did not concentrate either the administered ^{198}Au or the ^{131}I-ethiodol. A variety of histologic response was noted varying from foreign-body reaction with the appearance of histiocytes and giant cells (the result of irritation from the ethiodol) to complete destruction of the lymph node and, in some instances, destruction of melanoma cells within that lymph node. There were no severe complications from this treatment other than discomfort at the local site of injection; washing of this site with 1000 ml of saline solution prevented any untoward radiation effects. Mild nausea and vomiting were occasionally observed. No effects upon the hematopoietic system were noted. It is concluded that large doses of irradiation, varying from 20,000 to 50,000 rad, to the lymph nodes can be obtained by the intralymphatic administration of radioisotopes. (BBB)

22508 CLINICAL MANIFESTATIONS OF DISEASE AND THERAPEUTIC MEASURES IN CHRONIC EXPOSURE TO A ULTRAHIGH FREQUENCY (UHF) FIELD. Kapitanenko, A. M. Voenno-Med. Zh., 10: 19-23 (1964). (In Russian).

A group of 100 persons, 66 of whom were specialists at radar stations and 34 controls, were observed to determine the effect of uhf radiation on humans. The controls had the same living conditions and diet as radar workers, but were not subjected to uhf. Length of service by radar specialists was from 1000 hr to 2 yr or longer. The observations revealed deficiencies in the working capacity in the persons undergoing chronic uhf exposure and complaints of heightened fatigability, headache, irritability, loss of memory, insomnia, unpleasant sensations in the area of the heart, and tachycardia. The specialists with one year or more radar service and radar maintenance personnel who had not observed technical safety rules had many more subjective symptoms. Individual symptomatic treatment consisted of intravenous infusion of a 40% solution of glucose with ascorbic acid and B vitamins. Vasoactive drugs were also given to correct the cardiovascular anomalies. (BBB)

22509 RADIOAUTOGRAPHIC STUDIES OF THE TRANSPLANTED LEUKEMIA IN MICE. Goncharova, S. A.; Lipchina, L. P.; Frankfurt, O. S. (Inst. of Chemical Physics, Moscow). Tsitologiya, 9: 407-14 (Apr. 1967). (In Russian).

Black mice of the C 57 strain were inoculated with the leukemic strain La. On the 5th day after inoculation, when the spleen was significantly infiltrated with blast cells, thymidine-^3H (2 μCi/g) was injected. The generation time of blast cells at the periphery

of the spleen was 12 hours, the DNA synthesis phase, G_2 phase and the presynthetic period G_1 were 8.4, 2.4 and about 1 hour. The generation time of blast cells located in the center of the spleen was 15.6 hrs, the duration of phase S, G_2 and G_1 was 9.8, 3.2 and 2.6 hours, resp. Thus, blast cells in the center of the spleen proliferate somewhat slower than those at the periphery. The generation time of blast cells in the infiltrated liver was approximately the same as for blast cells at the periphery of the spleen. Incorporation of thymidine-^{3}H in parenchyma cells of the infiltrated liver was noted. The proliferative pool of blast cell population in the spleen and liver was 1.0, as shown by multiple injection of thymidine-^{3}H. In 45 minutes following injection of thymidine-^{3}H, 50 percent of blast cells in the circulating blood were found labelled. (auth)

22510 EXTERNAL SCANNING OF INTERNAL BETA-EMITTERS. Simon, N.; Feitelberg, S.; Warner, R. R. P.; Greenspan, E. M.; Edelman, S.; Baron, M. G. (Mt. Sinai Hospital, New York). J. Mount Sinai Hosp. N. Y., 33: 365-70(Sept.-Oct. 1966).

Methods were developed whereby available scanning devices were able to detect and record the distribution of β-particle emitting radioisotopes within the body. Scans of ^{90}Y injected intra-arterially and scans of ^{32}P injected intra-peritoneally were demonstrated in clinical applications. The detection of internally deposited isotopes which emit β particles has not been heretofore considered clinically feasible, since β particles, less penetrative than γ rays, are absorbed by a few millimeters of tissue. However observations indicated practical external detection of internal β emitters in the abdomen. Localizing a β-emitting isotope by measuring the β particles themselves would involve placing the detector inside or very close to the tissue containing the radioisotope. But β particles traversing through tissue lose some of their energy as bremsstrahlung, or secondary x rays. The efficiency of this conversion of energy to bremsstrahlung is low, especially in tissue which is of relatively low Z. Because of this known low efficiency little attempt has been made to detect internal β-emitting isotopes with scintillation crystal scanning equipment. Preliminary attempts to detect and scan ^{90}Y and ^{32}P within the abdomen resulted in scans which were surprisingly good and provided clinically useful data. These results were obtained in patients being treated with mCi amounts of ^{90}Y or ^{32}P for effusions secondary to metastatic cancer. (BBB)

22511 THE EFFECT OF MICROWAVE RADIATION ON MORPHOLOGY AND FUNCTION OF RAT TESTIS. Gunn, Samuel A.; Gould, Thelma Clark; Anderson, W. A. D. (Univ. of Miami School of Medicine, Fla.). Lab. Invest., 10: 301-14(Mar.-Apr. 1961).

Microscopic studies showed that exposure of the scrota of rats to microwaves (24,000 Mcps, 1.5 cm wavelength) a distance of 7.6 cm from the antenna (power density 0.250 w/cm^2) for 5, 10, and 15 min resulted in minimal, moderate, and severe testicular damage, respectively. Following exposure to microwaves, androgen levels were diminished, as indicated by the failure of the dorsolateral prostate to concentrate ^{65}Zn at normal levels. With 5-min exposure the cause of the diminished androgen output, evident 6 and 13 days after exposure, appeared to be due to insufficient luteinizing hormone (LH) output by the pituitary, since dorsolateral prostate ability to concentrate ^{65}Zn was restored by administration of testosterone propionate or chorionic gonadotrophin. By 29 days following the 5-min exposures androgen level was again normal. With 10-min exposures the cause of the diminished androgen output appeared to be 2-fold: a lack of sufficient LH output by the pituitary, as in the 5-min exposure group, and a failure of the testicular interstitial tissue to respond fully, to whatever trophic hormone was being elaborated, even though histologically the interstitial cells appeared normal. Experimental evidence for this interstitial tissue impairment was that, although ^{65}Zn uptake by dorsolateral prostate returned to normal levels after administration of testosterone, there was a complete lack of response to chorionic gonadotrophin. At 29 days following 10-min exposure the capacity of the dorsolateral prostate to concentrate ^{65}Zn was still depressed. (BBB)

22512 PLASMA RADIOACTIVITY AFTER RADIOACTIVE VITAMIN B_{12} GIVEN ORALLY. Coupland, W. W. (Prince Henry Hospital, Little Bay, Australia). Med. J. Austral., 1: 1020-3(June 11, 1966).

Various methods utilizing radioactivity measurements to assess absorption of radio-cobalt vitamin B_{12} are reviewed, and improvements in these methods are proposed. Until recently, measurement of plasma radioactivity was unsatisfactory because the isotopes of cobalt available possessed emission spectra which were unsuited to narrow window counting after pulse height analysis. This type of counting is necessary because of the low activity of plasma samples, and by using this method background activity is reduced considerably. Cobalt-57-labeled vitamin B_{12} is the ideal radioactive vitamin B_{12} preparation for use in studies of B_{12} absorption. It is a low energy isotope (122 KeV) with an emission spectrum characterized by a single peak. Cobalt-58-labeled vitamin B_{12} is commonly used for absorption studies. Cobalt-58 is more energetic than ^{57}Co, and thus exposes the patient to greater radiation hazards. It is unsuited to narrow window counting, for on pulse height analysis the emission spectrum is seen to have several major peaks. Cobalt-57-labeled vitamin B_{12} has a longer half-life than that labeled with ^{58}Co. Despite the longer half-life of ^{57}Co, the patient is submitted to less radioactivity because of the very low energy of its γ emissions. It was demonstrated that plasma radioactivity after oral ^{58}Co-labeled vitamin B_{12} administration was sufficient to allow a diagnosis of vitamin B_{12} malabsorption to be made. This provides the fastest measure of the degree of vitamin B_{12} absorption. There is a direct correlation of plasma radioactivity after oral ^{57}Co-labeled vitamin B_{12} administration with the urinary excretion, but only one sample need be collected, and a result is obtained within 9 hr of commencing the test. There are additional advantages in simplicity of method, esthetic appeal, and no need for patient cooperation in the collection of samples. Plasma radioactivity after oral ^{57}Co-labeled vitamin B_{12} administration gives an indication of the degree of vitamin B_{12} absorption in patients with renal failure, which condition invalidates the urinary excretion method. Clear distinction is provided between those subjects who can and those who cannot absorb vitamin B_{12}. This low-energy γ-emitting isotope submits the patient to less radiation than from any other isotope of cobalt, despite its longer half-life. (BBB)

22513 PROTOPORPHYRINEMIC LIGHT DERMATOSES. Langhof, H. Dermatol. Wochschr., 151: 896-7(July 24, 1965). (In German).

A light-induced dermatosis characterized by red fluorescing erythrocytes has been reported. This protoporphyrinemic urticaria was associated with extensive pseudomilium colloidal in the skin exposed to light, dark brown curly hair and leukonychia of several fingers, and pellagra-like hyperkeratoses on the backs of the hands. The dermatosis was exacerbated by long wave uv radiation and by violet light, and after only 1 to 1½ exposure to midday sunlight, with a latency of 3 min. Medication with chloroquine diphosphate was effective without increased porphyria, suggesting that porphyrin metabolism was disturbed at various sites. The erythrocyte protoporphyrinemia was 2000 to 4000 μg/100 ml erythrocytes, or about 100 times normal. The cases of light dermatitis reported by Kosenow were induced by uv light. Efforts to inhibit the protoporphyrin production have failed so far. Neither sulfhydryl drugs nor isonicotinic acid hydrazide, as a nicotinic acid antagonist, have any detectable effects. The red fluorescence of the erythrocytes disappears very rapidly during exposure to uv light. (BBB)

22514 PRESENT STATUS OF DERMABRASION. Epstein, Ervin (Highland-Alameda Co. Hospital, Oakland, Calif.). Calif. Med., 98: 79-82(Feb. 1963).

The use of skin planing, or dermabrasion, particularly for treatment of precancerous lesions of chronic radiodermatitis, is evaluated. Its value in preventing cancer in premalignant skin was studied in 3 representative patients, one with chronic radiodermatitis, one with multiple recurrent actinic keratoses and epitheliomas, and one with recurring cigarette-induced keratoses and epitheliomas of the lip. Two patients are still under observation 8 yr later, and the other was followed for more than 2 yr. All obtained decided benefit from skin planing. The patient with x-radiation damage has had several keratoses but much fewer than before operation. The one with the actinic-damaged skin has had no tumors in the planed areas, but many such keratoses developed in other areas. In the third patient with lesions of the lip, leukoplakia developed 3 yr after planing but this responded rapidly and apparently permanently to x-ray therapy. While the results showed that the method has not attained universal acceptance, 80% of dermatologists who have tried this approach, and who answered a questionnaire, rated the benefits obtained as excellent or good. Only 3.5% considered the results poor. (BBB)

22515 TONE SCALE AND SEPARATION IN DENTAL X-RAY EMULSIONS. Pentel, Leon; Goren, Arthur D. (New York Univ. Coll. of Dentistry). Oral Surg., Oral Med., Oral Pathol., 21: 748-60(June 1966).

Despite the fact that the high-kilovolt techniques are superior in lowering the total radiation dose delivered to the patient during dental radiography when used with the high-speed emulsions, the high-kilovolt (90-kVp), high-speed emulsion techniques produce images at pronounced variance with those produced with the low-kilovolt (65-kVp) techniques and moderate-speed emulsions. The low-kilovolt technique gives a contrasty image which yields optimal diagnostic information, but the radiation dose is higher. High-

kilovoltage offers sharply decreased doses needed for producing a radiographic image which many feel is inferior. This study was designed to explore a middle ground which would require less image-quality compromise while taking advantage of the lowered radiation doses available with the 90-kVp, high-speed-emulsion methods. The aluminum step-wedge technique was used to expose various grades of film to 65- and 90-kVp x rays, which were examined by densitometry. The results showed that it is not possible at present to duplicate the 65-kVp image produced on the less sensitive emulsions. This is probably because of the differences in beam quality, as well as the inherent properties of the high-speed emulsions. It is thought that, in spite of these drawbacks, a sufficiently satisfactory radiograph can be produced at materially lowered radiation levels through rigid control of developer, film, and temperature combinations. It is also believed that a more exhaustive investigation of film emulsion and developer behavior would result in an improved radiographic technique using lessened exposures. (BBB)

22516 CHEMICAL PREVENTION OF LESIONS CAUSED BY IONIZING RADIATIONS. Cozza, Alberto Ann Med. Nav. (Rome), 67: 724-40(Nov.-Dec. 1962). (In Italian).

This review considers the use of chemical agents to alter cellular radiosensitivity and the mechanisms whereby their effects are manifested. Interaction of these agents with the radicals (HO·, HO_2·, and O_2·) formed from the radiolysis of water is a likely site of action of chemical radioprotectors. Death of the cell can probably be attributed to irreversible changes produced in one of several types of macromolecules, which can be ameliorated by protective agents. Death of the cell appears to follow inability to enter or complete mitosis. Various types of macromolecules, such as enzymes, structural proteins, and nucleic acids, which may be the primary radiation target in the cell are considered. As potential target molecules, DNA and RNA are of first importance. The protection of active centers of enzymes, such as essential sulfhydryl groups, is another possible site of action of chemical protective agents. Processes which affect membrane permeability may also be involved. Systematic development of more effective protective drugs must await elucidation of the basic effects of ionizing radiation on cellular constituents. (BBB)

22517 INFLUENCE OF A MIXTURE OF CHEMICAL RADIOPROTECTORS ON THE CELLULAR RENEWAL IN THE DUODENUM OF MICE. Maisin, J. R.; Lambiet, M. (CEN, Mol, Belg.). Nature, 214: 412-13(Apr. 22, 1967).

It has been shown that cellular proliferation and migration in the intestinal epithelium are influenced by many factors, such as endocrine deficiency, starvation, exposure to ionizing radiation, etc. In the study described the influence of a mixture of reduced glutathione, aminoethylisothiouronium bromide (AET) and serotonin creatine sulphate on cellular renewal of the small intestine of mice was investigated. Data were obtained on duration of the mitotic cycle and on transit time of the crypt cells along the villi, employing ^{3}H-thymidine. After 1 hour the diminution of incorporation of the thymidine into the crypt cells was reduced to 58.7%, and after 4 hours to 79.3%. It appears that this mixture of protective agents does not have any direct influence on mitosis. The transit time of the crypt cells along the villi was markedly increased by the protective treatment. Results indicated that, after administration of the mixture of protective agents, the proportion of crypt cells in DNA synthesis was lower, and that the sum of times for predivision, mitosis and synthesis of the stem cells and the time during which cells were retained in a crypt, were longer than in controls. This confirms the hypothesis that transit time is dependent on rate of cell production, which in turn depends on the number of cells in the proliferative pool and on the duration of the generation time. A decrease in overall metabolic activity probably occurs as a consequence of biochemical shock produced by the large doses of thiol compounds, which initiate a sequence of intracellular changes altering the radioresistance of cells. (UKAE)

22518 ^{85}Sr KINETICS IN HYPOPARATHYROIDISM AT DIFFERENT LEVELS OF CALCIUM INTAKE. Litvak, J.; Oberhauser, E.; Riesco, J.; Lopez, O.; Armendaris, R.; Alliende, I.; Solis, F. (Univ. of Chile, Santiago). J. Nucl. Med., 8: 60-9 (Jan. 1967).

The kinetics of ^{85}Sr was studied in two normal controls and in three patients with hypoparathyroidism at different levels of calcium intake, based on a model of body calcium distribution of a single compartment. Bone accretion and the size of the space of exchangeable calcium were reduced in the three hypoparathyroid patients, while the half-life of the body isotope retention curve and of the serum specific activity curve were increased. These changes were constant and showed no relation to the calcium intake. The results obtained and the values of urinary hydroxyproline excretion suggest a decrease bone reabsorption rate in the patients studied. Failure to modify the kinetics of ^{85}Sr by changing calcium intake indicates presumably the absence of some degree of functional parathyroid reserve. (auth)

22519 THE ACRH BRAIN SCANNING SYSTEM. Beck, R. N.; Charleston, D. B.; Eidelberg, P.; Harper, P. V. (Argonne Cancer Research Hospital, Chicago). J. Nucl. Med., 8: 1-24(Jan. 1967).

A brain scanning system is described that consists of 4 collimated scintillation detectors, arranged in opposing pairs, which simultaneously scan the patient's head. Pulses from these detectors are fed to 4 pulse-height analyzers adjusted to accept only photopeaks for recording. The recording system consists of 4 light projectors which move with the detectors to produce a bell-shaped spot on film for each selected photopeak pulse. Count rate meters monitor each channel, but are not used for contrast enhancement or background erase. When used with a 10 mCi intravenous injection of ^{99m}Tc, the brain scanner produces simultaneous lateral photoscans in approximately 1 min., although superior pictures are obtained by 10 min scanning time. This quantity of ^{99m}Tc, administered as pertechnetate, produces a whole-body radiation dose of approximately 100 mR, the critical organ being the stomach, which receives approximately 3 rads. The performance of the scanning system components is described in detail. Since August 1963, the system has been used with good results to scan approximately 800 patients to detect a variety of brain lesions. Modifications of the system for use with a sliding couch and low-energy isotopes for the scanning of the thyroid gland with 1 detector, scanning of the kidney with 2 detectors, and lung and liver scanning with all 4 detectors are reported. (37 references.) (C.H.)

22520 THE EFFECTS OF X-IRRADIATION OF CEREBRAL GLIOMA (CLINICAL AND MORBID ANATOMICAL STUDY). Borghi, G. P. (Istituto Neurologico, Milan). Med. Nucl. Radiobiol. Lat., 7: 323-50(1965). (In Italian).

A report is given of a study of 99 patients with cerebral glioma, all of whom presented with a recurrence, for which most of them were reoperated upon. Of these patients, 66 were irradiated in the interval between the first and the second operation or between the first operation and their death, and in each of these cases it was possible to compare the histological sections of the primary tumor with those of the recurrence. Thirty-three other patients who also were subjected to a second operation for recurrence, but who received no irradiation between the first and second operation, were used as controls. In each of these cases, an analysis was made of the correlation between the survival, the intensity of the X-irradiation administered and the changes (if any) in the histological picture. It is concluded that glioblastomata appear to be histologically sensitive to X-irradiation but show no appreciable clinical signs of sensitivity; astrocytomata appear to be moderately sensitive from the histological point of view as well as clinically; X-irradiation appears to have an adverse effect on oligodendrogliomata. (auth)

22521 FIRST EXPERIMENTAL EVALUATIONS OF THE RADIOSENSITIZING EFFECT OF A NEW GROUP OF CYTOSTATIC DRUGS: THE METHYLHYDRAZINE DERIVATIVES. Agati, G.; Piccotti, F.; Toscano, G.; Isoardi, A. (Univ., Turin). Med. Nucl. Radiobiol. Lat., 7: 351-8(1965). (In Italian).

An experimental study was made of the antiblastic effect on the Ehrlich carcinoma of a new group of cytostatic agents, derived from methylhydrazine, which were used by themselves and in combination with ionizing radiations. Administration of the chemotherapeutic drug alone was followed by a distinct inhibitory effect on the growth of the tumour, of an intensity similar to that of the radiation. When the two forms of treatment were combined, a marked increase of the antiblastic action could only be observed if the methylhydrazine was administered immediately prior to the irradiation; if, on the other hand, the drug was administered after the irradiation, no potentiation of the antiblastic effect could be seen. (auth)

22522 SCINTIGRAPHIC LOCALIZATION OF THE PLACENTA BY USE OF ^{99m}Tc-LABELED ALBUMINS. Wiedermann, M.; Charamza, O.; Gazarek, F.; Krikal, J.; Kuba, J.; Husak, V. (Univ., Olomouc, Czech.). Fortschr. Geb. Roentgenstr. Nuklearmed., 106: 381-6(Mar. 1967). (In German).

The scintigraphic presentation of the placenta with ^{99m}Tc-labelled albumin was used on 13 pregnant women with satisfactory results. The examination is reliable, free from hazard and allows a clear visualization of the situation of the placenta. The possibilities of a differential diagnosis in cases of bleeding in the third trimester are considerably improved. The dose absorbed by the embryo as well as by the mother is considerably smaller than the radiographic methods. (auth)

22523 COMBINATION SCANNING PROCEDURES IN THE EVALUATION OF BRONCHOGENIC CARCINOMA. Sodee, D.

Bruce (Doctors Hospital and Renner Clinic Foundation, Cleveland Heights, Ohio. George Washington Univ., Washington, D. C.). J. Nucl. Med., 8: 25-34(Jan. 1967).

Lung scanning 24 hr following the intravenous administration of 1 mCi of ^{197}Hg-chlormerodrin followed by lung scanning immediately following the injection of 200 mCi of ^{131}I-macroaggregated albumin proved useful for the evaluation of bronchogenic carcinomas. It is pointed out that ^{197}Hg-chlormerodrin will localize in areas of active inflammatory disease as well as neoplastic tissues and a cellular diagnosis should be sought on each patient. Data are summarized on 52 patients evaluated for lung pathology using the combination scintillation scanning procedures. (C.H.)

22524 ^{99m}Tc HSA BLOOD POOL SCAN IN DIAGNOSIS OF AN INTRACARDIAC MYXOMA. Bonte, Frederick J.; Curry, Thomas S. (Univ. of Texas, Dallas). J. Nucl. Med., 8: 35-9 (Jan. 1967).

An intracardiac myxoma was demonstrated as a filling defect within the right side of the heart blood pool on a scan performed with ^{99m}Tc-labeled human serum albumin. The correct diagnosis was suggested preoperatively on the basis of scan and angiographic findings, and was confirmed by cardiotomy and histologic examination. Progressive increase in the size of the cardiac silhouette unaccompanied by increase in the pulmonary vascular volume suggests the need for a blood pool scan, not only to detect pericardial effusion, but the occasional intracardiac neoplasm. (auth)

22525 A SIMPLE METHOD OF ESTIMATING FOLIC ACID ABSORPTION (A MODIFIED FAECAL EXCRETION METHOD). Jeejeebhoy, K. N.; Ramanath, P.; Mehan, K. P.; Pathare, S. M.; Parekh, D. V.; Nadkarni, G. D.; Ganatra, R. D. (Atomic Energy Establishment, Trombay, India. Tata Memorial Hospital, Bombay). J. Nucl. Med., 8: 40-9(Jan. 1967).

A simple method of estimating folic acid gastrointestinal absorption is described that requires only a single random fecal sample for analysis after feeding ^{3}H-folic acid simultaneously with ^{51}Cr as chromic oxide. The absorption is calculated from the ratio of ^{51}Cr to ^{3}H in a stool collection made in the first 24 hr after the dose. The preparation of the radioactive compounds is described. Results obtained using the double tracer method are compared with those obtained by analysis of the total fecal collection after administration of a tracer dose of ^{3}H-folic acid. Applications in the diagnosis of megaloblastic anemia are discussed. (C.H.)

22526 A STUDY OF RADIOPROTECTIVE EFFECT OF MARINAMYCIN-LIKE ANTIBIOTIC 10484 ON A MODEL OF TUMOR CELLS. Klitsunova, N. V.; Ivanitskaya, L. P. Antibiotiki, 12: 307-12(Apr. 1967). (In Russian).

A procedure of cultivating cells of ascitic tumors of various strains in suspension in tubes, using as a criterion of the damaging effect of ionizing radiation the total number of cells in irradiated and non-irradiated cultures after 24 hours of incubation may be successfully used in studies on radioprotective properties of various substances. A marinamycin-like antibiotic isolated from the culture fluid of Act. candidus, strain 10484 had a pronounced radioprotective effect. (auth)

22527 INTRACAVITARY ELECTRON BEAMS THERAPY FOR THE PRIMARY LESION OF CERVICAL CANCER. Hamada, Tohru (Osaka City Univ.). Osaka Shiritsu Daigaku Igaku Zasshi, 15: 409-32(Oct. 1966). (In Japanese).

Clinical studies were made on the treatment of cervical cancer with 15-MeV betatron electron beam irradiation. Insertion of a tube with 2.8, 3.2, or 3.6 cm beam aperture into the vagina, intracavitary electron beams irradiation, a total of 6000 rho in 6 days (Group A: 25 cases) or 8000 rho in 8 days (Group B: 10 cases, Group C: 15 cases), was administered in 50 cases of cervical cancer, stage I or II. The 15 cases of Group C which had been administered intracavitary electron beams (8000 rho) were given external 15 MeV betatron X-rays, i.e., a total tumor dose of about 4000 rho in 30 days. On macroscopy, colposcopy, colpomicroscopy, and histopathological examination, the during- and post-irradiation effects were markedly observed in the early period. About 1 month after irradiation, Okabayashi's radical panhysterectomy was performed in 30 cases. In 18 cases of these 30 cases the uterine cervix showed no histopathological malignancy. Radiation dose given to the uterine cavity, urinary bladder and rectum was measured with a fluoro-glass dosimeter in 10 patients. General and local untoward reactions were hardly observed during and after treatment. When the primary lesion of the uterine cervix is small and superficial, intracavitary electron beams therapy is very effective, because of a large dose (6000 ~ 8000 rho) can be administered in several days electively on the local lesion without marked untoward reactions. For advanced cases, external irradiation and/or intracavitary small source therapy should be added to this therapy. (auth)

22528 RADIATION SICKNESS (PHYSIOPATHOLOGICAL PROBLEMS–THERAPEUTIC PRACTICES). Nuvolone, U. (Ospedale Maggiore, Novara, Italy). Med. Nucl. Radiobiol. Lat., 9: 79-116(1966). (In Italian).

The clinical picture of radiation sickness is described, and reference is made to the pathogenic theories in general and, in particular, to the problems of physiopathology connected with the part played by the adrenal cortex in radiation sickness. Pharmacological treatment of radiation sickness is dealt with along with the general rules of the management of subjects exposed to radiation, the glycocorticoids, the antivagal, antitoxic, and antihistaminic treatment and radioprotection. In each chapter, brief reference is made to the physiopathological conceptions that justify the use of the various drugs, and the substances commonly used in clinical treatment are listed. (auth)

22529 EARLY LOCAL POSTIRRADIATION REACTIONS IN PATIENTS TREATED WITH X-RAYS FOR LARYNGEAL CARCINOMA. Klonowski, Stanislaw; Peszynski, Jerzy. Ann. Univ. Mariae Curie-Sklodowska, Lublin-Pol., Sect. D, 20: 299-302 (1965). (In Polish).

In the group of 88 patients treated with x rays for laryngeal carcinoma early postirradiation reactions were observed. The reactions were divided into four stages. A decrease in the intensity of the post-irradiation reactions was obtained in group II (30 patients treated with shorter x rays, smaller field—16.8% of complications were observed) when compared with group I (58 patients treated with softer x rays, larger field—50% of complications were observed). (auth)

22530 RESULTS OF BIOPHYSICAL STUDIES IN THOROTRAST PATIENTS AND THEIR SIGNIFICANCE FOR THE ESTABLISHMENT OF MAXIMUM PERMISSIBLE MASSES OF RADIONUCLIDES. Muth, H.; Grillmaier, R.; Oberhausen, E. (Univ., Saarlandes, Homburg, Ger.). pp 10-17 of Biophysikalische Probleme der Strahlenwirkung. Muth, H. Stuttgart, Georg Thieme Verlag, 1966. (In German).

In a series of patients who had received Thorotrast injections the following measurements were carried out: measurements in the whole-body counter for the determination of the body content of ^{208}Tl, ^{228}Th, ^{228}Ac, and ^{226}Ra; measurement of the ^{220}Em concentrations in the breath; measurement of the concentration of the Th daughter products in the blood; and measurement of the elimination of Th daughter products in the stool and urine. Typical results were shown graphically and in tabular form. An evaluation of the results shows that the very schematic method of the ICRP for the calculation of the maximum permissible values leads to results which in many cases vary significantly from the actual values. The greatest uncertainty lies in the distribution pattern of the radionuclide strongly deviating from the standard case of the ICRP on occasion. (J.S.R.)

22531 THE RADIATION BURDEN OF SKELETON AND LUNGS IN THOROTRAST PATIENTS. Grillmaier, R.; Muth, H.; Oberhausen, E. (Univ., Saarlandes, Homburg, Ger.). pp 18-21 of Biophysikalische Probleme der Strahlenwirkung. Muth, H. Stuttgart, Georg Thieme Verlag, 1966. (In German).

The α radiation dose received by the lungs and skeleton was evaluated as a function of time for 45 Thorotrast patients who had received the Thorotrast by intravenous injection. The results are graphed. (J.S.R.)

22532 THE RADIATION DOSE AND ITS TIME PATTERN AFTER INCORPORATION OF ^{226}Ra AND ^{224}Ra (ThX THERAPY). Oberhausen, E. (Univ., Saarlandes, Homburg, Ger.). pp 22-5 of Biophysikalische Probleme der Strahlenwirkung. Muth, H. Stuttgart, Georg Thieme Verlag, 1966. (In German).

The radiation dose and its time pattern after incorporation of ^{226}Ra and ^{224}Ra were evaluated on the basis of the four-compartment model of K metabolism. The results are graphed. ^{226}Ra is enriched relatively rapidly in the skeleton system and attains its maximum after approximately a day. Its concentration then slowly decreases and after ten days is approximately 15% of the injected activity. In ^{224}Ra the maximum is attained earlier and the curve falls more sharply and almost reaches zero after ten days. It was estimated that during the first ten days the ratio of the radiation dose of ^{224}Ra to that of ^{226}Ra is 1.2. After this time the radiation effect of ^{224}Ra is practically ended but that of ^{226}Ra lasts for a decade. (J.S.R.)

22533 THE MINIMUM DAMAGE DOSE BY RADIATION: CALCULATION OF THE RADIATION DOSE IN BONE MARROW AND MARROW-FREE SKELETON AFTER INCORPORATION OF COLLOIDAL ThO_2 (THOROTRAST). Kaul, A.; Rajewsky, B. (Max-Planck-Institut fuer Biophysik, Frankfurt am Main). pp

34-47 of Biophysikalische Probleme der Strahlenwirkung. Muth, H. Stuttgart, Georg Thieme Verlag, 1966. (In German).

The distribution of ^{232}Th and its daughter products in the reticuloendothelial system and in the marrow-free skeleton was calculated. The results showed that approximately 70% of the total body content of ^{232}Th is in the principal storage organs of the reticuloendothelial system, the liver, and spleen and 30% is in the trabecular bone marrow with less than 1% in the marrow-free skeleton. The time modification of the distribution of ^{232}Th and its daughter products in the skeleton was then outlined. The radiation dose output and the total dose accumulated in the skeleton at various times after incorporation were calculated. The results showed that the minimum dose for the induction of osteosarcomas in man under chronic irradiation is above a value of at least 1,200 rem. The significance of these results is discussed with respect to the microscopic distribution of the radioactive substances in bones. (J.S.R.)

22534 THE RADIATION PROTECTION EFFECT OF PYREXAL. Flemming, K. (Institut fuer Experimentelle Biologie, Heiligenberg, Ger.). pp 138-40 of Biophysikalische Probleme der Strahlenwirkung. Muth, H. Stuttgart, Georg Thieme Verlag, 1966. (In German).

The radiation protection effect of pyrexal administered before and after a whole body x irradiation at 640 to 690 R was evaluated by the survival rate of the mice. The pyrexal was injected intravenously. Injection both before and after irradiation increased the survival rate, but injection before the irradiation was more efficient. The possible mechanism of the protective effect of pyrexal is examined in some detail. (J.S.R.)

22535 APPLICATION OF ANALOG COMPUTERS IN BIOLOGICAL AND MEDICAL RESEARCH. Habermehl, A.; Graul, E. H. (Univ., Marburg/Lahn, Ger.). pp 168-76 of Biophysikalische Probleme der Strahlenwirkung. Muth, H. Stuttgart, Georg Thieme Verlag, 1966. (In German).

With the analog computer a series of biological and medical questions can be studied. It makes it possible to compare simply experimental results with the theoretical values calculated on the basis of a model and to obtain a better understanding of the processes occurring. The effect of the various factors can easily be established. If the behavior of a biological system is known and therefore a model can be constructed, the analog computer can be used for the evaluation of solution curves and for the determination of constants pertinent to a given individual system. Then an evaluation device can be constructed which corresponds to this model and with which the evaluation of these special curves is possible without the use of an analog computer. (tr-auth)

22536 HYPERBARIC OXYGEN AS AN ADJUVANT TO RADIATION THERAPY OF CANCER. Wildermuth, Orliss (Swedish Hospital, Seattle, Wash.). Progr. Clin. Cancer, 2: 172-84(1966).

Radiobiological aspects of the adjuvant effect of hyperbaroxia in radiotherapy of neoplasms of the esophagus and larynx are reviewed and discussed, with emphasis on the molecular site of oxygen enhancement of radiosensitivity. Clinical results and complications in a large series of patients are reported. (TSS)

22537 RADIOPHARMACOLOGY OF A SIMPLIFIED ^{99m}Tc-COLLOID PREPARATION FOR PHOTOSCANNING. Larson, Steven M.; Nelp, Wil B. J. Nucl. Med., 7: 817-26(Nov. 1966).

Using a modification of a method suggested by Patton, ^{99m}Tc-sulfur colloid can be rapidly produced by the reaction of thiosulfate with pertechnetate and perrhenate (ReO_4^-) carrier. The factors influencing the rate of reaction, ^{99m}Tc-colloid yield and resultant colloidal particle size are presented. The colloid can be stabilized with Dextran and, for daily use, aliquots of the reactants can be stored in a pre-mixed sterile form. Using such a "colloid kit" ^{99m}Tc-colloid of 400 μ size can be routinely prepared in less than five minutes with 98% yield. The preparation is very suitable for photoscanning organs of the RES in man. (auth)

22538 CHANGES IN THE LEUCINE AMINOPEPTIDASE ACTIVITY OF THE BLOOD SERUM IN EXPERIMENTAL RADIATION SICKNESS AND IN DEGRANOL POISONING. David, Gabor. Honvedorvos, 18: 137-42(Apr.-June 1966). (In Hungarian).

Changes in the serum leucine aminopeptidase (SLAP) activity in experimental radiation sickness and in Degranol poisoning (DL_{50}/5 days) were studied in rats. It was found that there is a decrease in enzymatic activity as early as 24 hours after irradiation and this decrease continues during the following 2 to 3 days. On the fifth day, the SLAP activity of some of the animals falls to an extremely low level while in the others, it remains at the level reached on the third day. In the case of Degranol poisoning, after 24 hours the SLAP activity is lower than that of the animals having radiation sickness. The activity remains below the values seen in radiation sickness on the second and third days as well. On the fifth day, however, it shows a slightly increasing tendency. (JPRS)

22539 ^{90}Sr β-IRRADIATION, CATARACTOGENICITY, AND PTERYGIUM RECURRENCE: RESULTS OF A POSTIRRADIATION SURVEY FIVE TO SIX YEARS AFTER TREATMENT. Hilgers, J. H. C. Arch. Ophthalmol., 76: 329-33(Sept. 1966).

A follow-up study was conducted in 70 patients (with 83 irradiated eyes) to evaluate the effectiveness and hazards of ^{90}Sr β irradiation for recurrent pterygium. A fractionated total dose of 3000 Rep, given to 27 eyes, did not produce lenticular opacities. A surface dose of 3000 Rep at the limbus is considered a safe noncataractogenic dose of ^{90}Sr irradiation. Fractionated total doses ranging between 3000 and 5000 Rep were given to 46 eyes. One eye receiving 3400 Rep and two eyes each receiving 5100 Rep showed opacities, an incidence of 3 in 46 eyes (6%). All 3 were posterior, subcapsular, and peripheral opacities. There were no posterior polar lens changes and there was no interference with vision. The opacities appeared benign clinically, being localized and nonprogressive. The optimum dose of ^{90}Sr β irradiation to prevent pterygium recurrence was 5000 Rep: it gave the lowest recurrence rate, 1 eye out of 32 eyes (3%). Irradiation doses of less than 5000 Rep had a higher recurrence rate, 10 out of 51 eyes (19%). However, the optimum dose of 5000 Rep far exceeds the noncataractogenic dose of 3000 Rep. Considering the low incidence of the opacities and the benign clinical appearance, it seems justified to continue the use of a fractionated total dose of 5000 Rep to maintain the lowest possible rate of pterygium recurrence. Other complications of ^{90}Sr β irradiation were noted, such as irradiation vacuoles (in 7 of 46 eyes, 15%) and telangiectasis of conjunctival vessels (5 of 73 eyes, 6%). Changes in eye pressure (glaucoma or hypotony of the irradiated eye) were not observed. Neither was corneal ulceration or keratinization of conjunctival epithelium noted. (BBB)

22540 EFFECT OF DELAYED ISOGENIC RESTORATION ON THE SURVIVAL OF X-IRRADIATED MICE. Duplan, J. F.; Jahkola, M. (Institut du Radium, Paris). Ann. Med. Exp. Biol. Fenn., 44: 326-32(1966).

The influence of the following variables on hematopoietic cell replacement in irradiated recipients was examined: (1) the time interval between irradiation and restoring injection; (2) the number of cells in the inoculum; and (3) the efficiency of repeated injections after 24, 48, or 72 hr in comparison to that of a single injection. Inbred mice of the strain XVII, x irradiated with 800 R, were injected with isogenic bone marrow cells 6 to 8 days after irradiation to study the mechanism of delayed restoration after a lethal dose of irradiation. A single injection of 1.8×10^7 nucleated cells given after 6 days resulted in 100% survival, whereas 4×10^7 cells gave only a 17% survival when the restoration was performed after 8 days. The effect of an injection given 7 days after irradiation could be considerably enhanced by a second injection given 72 hr later. The same result could be obtained when the first injection was given on the 9th day and the second on the 10th. In both cases the last injection was given at a period when single injections were no longer effective. These results confirm that the restoration is exclusively due to the injected stem cells, and a two-step mechanism of recovery is suggested. The survival of the animals would depend on the immediate action of mature or maturing hematopoietic cells present in the inoculum, which would only later be replaced by cells originating from the injected stem cells. (BBB)

22541 EXTENDED RADIOTHERAPY IN ADVANCED HODGKIN'S DISEASE: HEMATOLOGIC ASPECTS. Johnson, Ralph E.; Foley, H. Thomas; Steckel, Richard J.; Glenn, Dwight W. (National Cancer Inst., Bethesda, Md.). Arch. Int. Med., 118: 70-4 (July 1966).

Hematologic changes were recorded in 6 patients undergoing intensive therapy with the 2-MeV Van de Graaff accelerator. The tolerance of the hematopoietic system is a major consideration when using radiotherapy as the primary treatment for advanced disease. Significant bone marrow depression was anticipated with high-dose irradiation of these multiple sites, and the question posed was the capacity of the bone marrow to accept such an extensive insult without major morbidity or mortality. The dose to individual areas was fractionated (5 to 6 treatments per week) so that the weekly min tumor dose was 1000 to 1200 R. Uninvolved segments were irradiated with a min tissue dose of 2000 R, and in some instances full therapeutic doses of 3000 R or more were given prophylactically. The alterations in the peripheral white blood cell count, hemoglobin, and platelet count are shown. A consistent leukopenia was observed with a median nadir of 1700 cells/mm^3 (range 1400 to 2400). Thrombocytopenia was regularly noted with a median nadir of 82,000 (range 73,000 to 125,000). Changes in hemoglobin were less consistent and the differential blood counts were not strikingly modified, except for eosinophilia. Most patients experienced nausea, occasional emesis, pharyngitis, esophagitis, and mild diarrhea. However, only one patient required hospitalization for several days because of severe radia-

tion sickness. The mean weight loss during the course of therapy was 3.2 kg (7 lb). There were no serious complications attributable to treatment aside from those described above. One patient developed a severe case of herpes zoster 4 months after completion of irradiation. (BBB)

22542 SCINTILLATION SCANNING OF AN INTRAMUSCULAR ^{133}Xe INJECTION SITE. Clapham, W. F.; Gimlette, T. M. D. (St. Thomas's Hospital, London). J. Physiol. (London), 185: 56P-57P(1966).

In the estimation of muscle blood flow by the measurement of clearance of injected ^{133}Xe, change in the size or position of the injection site during the time of the study could introduce error. This was investigated by scanning the injection site with a collimated scintillation counter. The detector was a $\frac{3}{4} \times 1\frac{1}{4}$ in. sodium iodide crystal with a single-hole tapered collimator, ID 2.7 cm proximally, 1.0 cm distally, length 7.0 cm. With a 0.4 cm dia ^{133}Xe source 2.5 cm from the end of the collimator, the detector showed a resolving power (full width at half max counts) of 1.4 cm. One-tenth ml ^{133}Xe in saline (100 μC) was injected 2 cm into the lateral gastrocnemius of a human subject. Scanning the injection site showed that the injected radioactivity remained in a small volume of muscle not exceeding 1.0 cm in greatest dia and not changing appreciably during the 50-min period of the study. (BBB)

22543 MOVEMENT OF RADIOACTIVE CALCIUM FROM URINE TO RACHITIC RAT CARTILAGE. Parsons, Richard P. (Washington Univ., St. Louis). Invest. Urol., 4: 73-8(July 1966).

The in vitro incorporation of radiocalcium in rachitic rat cartilage incubated in urine from patients with calcification disorders was examined. Urine from patients with ileal segments (for urinary diversion) and calculus disease was found to deposit significantly more calcium in the cartilage than did the urine from patients with ileal segments but no calculi. The results of the measurement of radioactivity were correlated to the mineralization of bone as determined by light microscopy. This method using ^{45}Ca is recommended as the superior one for detecting urinary evidence of calcification abnormalities of this nature. Calcium-47 emits chiefly γ radiation and has a half-life of 4.7 days. With the use of 1.0 μC, adequate radioactivity is present for easy counting. This isotope is relatively cheap and safe for laboratory personnel and requires no elaborate filtering or disposal measures because of its physical characteristics. This radioactive uptake method of determining the deposition of calcium from solution to cartilage proved to be much easier and faster than the use of histologic preparations for microscopic evaluation. Counting of radioactivity permits more objective evaluation than estimation of the degree of mineralization present in a microscopic section. (BBB)

22544 SUBTOTAL OR TOTAL PITUITARY ABLATION BY IMPLANTATION OF RADIOACTIVE RODS. Fraser, T. Russell; Joplin, G. F. (Postgraduate Medical School, London). Mod. Treat., 3: 189-204(Jan. 1966).

Procedures, isotopes, and doses used, indications for, and complications from radiohypophysectomy are described. Two isotopes are most suitable for implantation: ^{90}Y, which is a β emitter (half-life 2.54 days), whose irradiation falls off very rapidly with distance, and ^{198}Au, a γ emitter (half-life 2.60 days), which gives a more widely penetrating irradiation. Because of its limited radius of irradiation, ^{90}Y is much more suitable for destruction of a small structure like the pituitary. To enable one to calculate the ideal length and activity for the sources, depth-dose data are given. The most convenient way of expressing the administered irradiation dose to the pituitary gland is by gland surface or rim dose, i.e., the dose which will be reached at the gland surface. As the dose of the diaphragma sellae is critical with respect to the risk of complications, it is the dose to this structure which is most usefully specified. The procedure is planned to give as nearly as possible the same dose to all the other surfaces of the gland. It was found that for total destruction of the normal anterior pituitary, about 300,000 rad must reach the gland surface, although near-total ablation can often be obtained with half this dose. With 50,000 rad, hypopituitarism is rarely induced. For pituitary tumors, where hypopituitarism is not required, a surface dose of between 20,000 and 50,000 rad is suitable. The implants carry some risk of cerebrospinal fluid (CSF) rhinorrhea which seems directly related to the irradiation dose used and the precision of rod placement. The risk of rhinorrhea is minimal with implants planned for partial ablation, except with sellae expanded by tumors. Persistent rhinorrhea can usually be arrested by inserting a stainless steel screw. Among the 32 cancer patients implanted by the described technique with ^{90}Y, with a planned dose of 200,000 to 300,000 rad at the diaphragma sellae, 6 had either a CSF leak or signs of infection. All cleared, either with antibiotics alone, or after insertion of a stainless steel screw. The only serious morbidity among the diabetic retinopathy implants was infection related to CSF leakage; there was no optic or oculomotor nerve damage. Of 36 operations on diabetics implanted with two ^{90}Y rods as described, using a variety of irradiation dose levels, 3 sustained infection; among these there was 1 death. (BBB)

22545 PITUITARY ABLATION FOR DIABETIC RETINOPATHY. Joplin, G. F.; Fraser, Russell; Hill, D. W.; Oakley, N. W.; Scott, D. J.; Doyle, F. H. (Postgraduate Medical School, London). Quart. J. Med., 34: 443-62(Oct. 1965).

Implantation of ^{90}Y in the pituitary was used to treat 38 patients with diabetic retinopathy. Technique, doses, complications, and clinical results are reported. In all patients, radioyttrium oxide rods were implanted through cannulae inserted into the pituitary fossa under fluoroscopic control using an image intensifier. In an attempt to establish the relative merits of complete and partial pituitary ablation, 3 radiation doses were used; expressed as dose to the gland periphery, these were initially 100,000 to 200,000 rad, then 300,000 rad, and later 50,000 rad. Because of the various levels of radiation delivered to the pituitary, and degree of the pituitary ablation obtained, the endocrine effects observed varied considerably. While the so-called slight pituitary ablation group generally showed no endocrine effects, the maximal ablation group usually showed full hypopituitarism. Myxedema emerged between the second and the fifth month. In 6 patients treated with 100,000 to 200,000 rad, 24-hr urinary 17-oxygenic steroid (17-OGS) levels 3 days after corticosteroid withdrawal were undetectable. Three patients treated with 50,000 rad had normal basal urinary 17-OGS values. In two premenopausal women treated with the highest radiation dose (300,000 rad), menstruation ceased after implantation. Complications of implantation are listed. No optic or oculomotor nerve damage occurred. The main complication was cerebrospinal rhinorrhea, which sometimes led to meningitis. Pituitary ^{90}Y implantation was also occasionally followed by temporary diabetes insipidus and exacerbations of pre-existing postural hypotension. Cerebrospinal rhinorrhea occurred in 8 patients, in 3 being followed by meningitis. Half the leaks began in the first 3 weeks after implantation, the others all within a period of 2 months. Eight patients experienced post-operative diabetes insipidus severe enough to require hormone treatment. In 4 patients postural hypotension worsened after the pituitary ablation. Five components of retinopathy were evaluated. Improvement was seen in hemorrhages (50%), in new vessels (30%), and in venous dilatation (20%); exudates remained unchanged while retinitis proliferans continued to advance. (BBB)

22546 CEREBRAL IMPLANTATION OF RADIOACTIVE MATERIAL. Hankinson, John (Newcastle General Hospital, Newcastle upon Tyne, Eng.). Intern. J. Neurol., 5: 94-104(1965).

Problems associated with implantation of various radioisotopes in the brain are discussed, with emphasis on those dealing with dose calculations and prevention of complications. The choice of isotopes giving rise to β or γ emission or to varying proportions of both is discussed in regard to their physical properties. Gold-198 at low dosage has a penetration of β rays in water or in soft tissues amounting to no more than 1.5 to 2 mm, but at higher dosage (above 20 mC) the volume of tissue destruction is increased, due to the γ radiation. Changes also follow the use of the γ emitters of long half-life, namely ^{182}Ta, ^{193}Ir, and ^{60}Co. Yttrium-90 however, is a pure β emitter, its range being limited to a few mm in brain tissue with valuable applications in hypophyseal surgery. However, in general, it seems unlikely that tumors of a diameter greater than 4 cm can be effectively treated by interstitial irradiation as shown by dosimetric calculations. Small (2 to 3 cm dia), surgically inaccessible, but strategically placed, tumors are best suited to interstitial irradiation. One to 2 mC of ^{198}Au introduced by a stereotaxic instrument and distributed symmetrically in the tumor have proved satisfactory. The dosage and distribution are planned to provide 7000 to 10,000 rad. Six patients are reported to be alive and apparently well two to six years after such treatment. Pituitary adenomas can be best treated by the combination of a β and γ emitter such as ^{90}Y and ^{198}Au. This is indicated in the treatment of the hormonal disturbances of the eosinophilic and basophilic adenomas and in cases of chromophobe adenomas and craniopharyngiomas. For pituitary ablation, two symmetrical sources of ^{90}Y of 4.5 mC each were implanted, producing a total irradiation of 12,000 to 14,000 rad. As to complications, of the 120 cases, 12 sustained some degree of visual disturbance, usually a few months after treatment. Transient ptosis occurred in two cases, polydipsia, usually transient, occurred in 12 cases, and cerebrospinal fluid leak was observed in five cases. (BBB)

22547 RADIOFLUORIDE PHOTOSCANNING OF BONE FOR RETICULUM CELL SARCOMA: EARLY DETECTION OF BONE INVOLVEMENT. Dworkin, Howard J.; Filmanowicz, Edward V. (Univ. of Michigan, Ann Arbor). J. Amer. Med. Ass., 198: 985-8(Nov. 28, 1966).

A method of radiofluoride bone scanning was developed. The

^{18}F is produced as the carrier-free sodium salt by bombarding ^{6}Li-enriched lithium carbonate with thermal neutrons in a reactor under sterile conditions. A dose of 1 mC of ^{18}F, in 5 to 10 ml, is administered orally or intravenously and scanning is done 1 hr later, the time necessary to achieve a good target-to-nontarget ratio. Proximity to the place of production is necessary, since ^{18}F has a half-life of 110 min. This procedure was performed in over 70 patients with no untoward reactions. The radiation dose is about 0.12 rad to bone. A commercial 3 × 2-in. NaI(Tl) crystal photoscanner was used. Clinical results showed that radiofluoride bone scanning is a sensitive means for detecting the bone lesions of reticulum cell sarcoma. This is in contrast to methods of bone photoscanning with radioisotopes of strontium which have failed to detect these lesions. Four patients with reticulum cell sarcoma involving bone were studied with ^{18}F bone scans. All 4 patients were scan-positive for the bone lesions which were eventually demonstrated on roentgenograms or at postmortem examination. X-ray studies of the bone were non-diagnostic in 2 of the patients. In one patient, a good clinical response to radiotherapy was correlated with a relative decrease in ^{18}F uptake in the treated area. (BBB)

22548 EFFECT OF PROPYLTHIOURACIL AND ^{131}I ON BLOOD PRESSURES OF THYROTOXIC PATIENTS: A RETROSPECTIVE STUDY. Boone, A. Gary; Langford, Herbert G. (Univ. of Mississippi, Jackson). S. Med. J., 60: 24; 29(Jan. 1967).

The mean systolic blood pressure of hyperthyroid patients dropped significantly from 151 to 134 mm Hg after treatment with ^{131}I. The mean reduction of diastolic pressure of 0.41 mm Hg was not significant. After treatment with propylthiouracil (PTU) the reduction in systolic pressure was 7 mm greater than with ^{131}I. The mean reduction of diastolic pressure of 3.71 mm Hg after PTU was not significant. (BBB)

22549 PREOPERATIVE IRRADIATION IN BRONCHOGENIC CARCINOMA. Manfredi, Felice; King, Robert; Behnke, Roy; Heimburger, Irvin (Veterans Administration Hospital, Indianapolis, Ind.). Amer. Rev. Respirat. Dis., 94: 584-8(Oct. 1966).

Clinical results and complications encountered in a program combining preoperative irradiation and surgical resection in the treatment of 38 patients with bronchogenic carcinoma are described. The therapy plan consisted of ^{60}Co irradiation therapy of 4000 to 4600 rad delivered to the primary site and mediastinum through anterior and posterior ports over a 4-week period. Two months from the beginning of therapy, surgery was performed. The results indicated that irradiation therapy with high doses of ^{60}Co before surgery does not improve the resectability rate nor the survival rate, and is associated with a high incidence of complications. Such preoperative irradiation provides no advantage over surgical resection alone and should not be considered as satisfactory therapy in patients with bronchogenic carcinoma. Major postoperative complications included bronchopleural fistulas and deaths. Pulmonary infection and pulmonary insufficiency appeared to be the cause, or at least the factors most directly leading to the death of the 3 patients. (BBB)

22550 GRID DIAPHRAGM IMAGE DIFFUSER FOR SECONDARY RADIATION CONTROL. McNeill, R. William (Univ. of Washington, Seattle). Angle Orthodontist, 36: 63-7(Jan. 1966).

A lightweight grid diffusion assembly designed specifically for adaptation to roentgenographic cephalometric systems is described which decreases patient exposure, especially from scattered radiation, and gives more distinct radiograph shadows. (TSS)

22551 ROLE OF SCINTILLATION SCANNING IN CLINICAL MEDICINE. PART I. Freeman, Leonard M.; Schneider, Joel A.; Kay, Chester J.; Zingesser, Lawrence H.; Zimmerman, Charles (Albert Einstein Coll. of Medicine, Bronx, N. Y.). N. Y. State J. Med., 66: 2020-8(Aug. 1, 1966).

In this first part of a 3-part review (with 111 references) of applications of γ-ray-emitting radioisotopes in medical diagnosis, principles of scanning, selection of isotopes, doses used, radiation exposure levels to the patient, and clinical results are given. A list of isotopes used for brain scanning is provided. Certain physical advantages of ^{203}Hg over ^{131}I in brain scanning are discussed. The γ emission of ^{203}Hg is abundant and its energy, 0.28 MeV, is low enough to be focused well by a 19-hole collimator. Another physical advantage stems from the fact that the β radiation of ^{203}Hg is of lower energy than the β rays from ^{131}I. Other advantages, also related to patient irradiation, result from the fact that the small molecule of chlormerodrin used has a much shorter biologic half-life than the large molecule of serum albumin labeled with ^{131}I. When ^{197}Hg, which has physical half-life of 2.6 days compared with the half-life of 46 days of ^{203}Hg, is used in the chlormerodrin, the radiation dose that the patient receives is further minimized. However, the γ emission of ^{197}Hg is considerably lower than that of ^{203}Hg, and this might limit its usefulness. Technetium-99m is now employed widely because of its advantages, mainly its 6-hr physical half-life. Extremely large doses, such as 10 mC, can be given safely. In heart blood pool scanning, γ-emitting materials that remain in a vascular pool such as that of the heart or aorta long enough to be scanned are used. Initially, serum albumin tagged with ^{131}I was used, but ^{131}I-iodipamide (Cholografin) is preferable because of its rapid clearance by the liver, that results in a whole-body dose of only 0.025 rad as compared with 0.5 rad when radioiodinated albumin is used. A new, promising agent is human serum albumin labeled with ^{99m}Tc. Radioiodinated ^{131}I-MAA (macroaggregrated human serum albumin) is the main agent used in lung scintiscanning. Eighty percent of the radioactivity appears in the urine within 48 hr, and the total dose can be accounted for in several weeks. The total radiation exposure to the lungs and liver is 0.3 rad after the standard dose of 300 μC. Extensive testing for potential toxicity performed in rats showed the median lethal dose to be 5000 times that used in clinical scanning (5 to 30 μg/kg), thus providing a large margin of safety. (BBB)

22552 A REVIEW OF THE LITERATURE ON THE RADIATION DOSAGE REQUIRED TO CAUSE MANIFEST CENTRAL NERVOUS SYSTEM DISTURBANCES FROM IN UTERO AND POSTNATAL EXPOSURE. Yamazaki, James N. (Univ. of California, Los Angeles). Pediatrics, 37: Suppl., 877-903 (May 1966).

Data reported in the literature from experimental studies on animals and observations on man regarding the effects of radiation in utero are reviewed, so that the possible danger of ionizing radiation to the human embryo may be better assessed. A total of 137 publications was examined. The experimental evidence amply demonstrated the vulnerability of the embryonic and neonatal mammalian nervous system to ionizing irradiation during early ontogenetic development. Exposure to small doses (10 to 30 R) during early morphogenesis may produce morphological, neurophysiological, and behavioral changes becoming manifest after latent periods of varying intervals extending well into adulthood. Hereditary factors play an important role in determining the differential response to radiation in individuals and between species. Observations on man, although meager, indicate that the developing human nervous system is severely injured by large doses of ionizing radiation. However, the hazard of exposure to small doses of radiation, calculated for the developing neural tissue of some animals under experimental conditions, has not been demonstrated to be equivalent in the human. Although extrapolation of these experimental data to man is not fully warranted, they indicate the potential hazard from small exposures to radiation. (BBB)

22553 THE MANAGEMENT OF PTERYGIA: WITH SPECIAL REFERENCE TO SURGERY COMBINED WITH BETA IRRADIATION. Haik, George M.; Ellis, George S.; Nowell, John F. (Louisiana State Univ., New Orleans). Trans. Amer. Acad. Ophthalmol., 66: 776-84(1962).

Use of Ra and ^{90}Sr for local irradiation of pterygium in 424 cases is described, with attention to prevention of radiation injury of the eye, particularly cataract. It was found that recurrences can best be prevented by simple excision or by a technique combined with irradiation during the operative procedure. Thus, radiation is used as an adjunct to surgery. The application of a 900 to 1000 rad dose from a ^{90}Sr applicator to the limbus in the course of the operation obliterates newly budding capillaries and reduces fibroblastic proliferation and cell infiltration. Vessels visible to the naked eye, whether superficial or deep and whether old or new, require dangerously high doses of radiation, which may produce local necrosis and telangiectasis and which are almost certain to damage the lens. Beta radiation should be used in the management of pterygium with a full appreciation of its possible risks to the lens. No radiation cataracts were found in the 249 cases treated by the combined technique which is described here, as compared with 9 instances in the 175 cases treated earlier. There has been no postirradiation cataract in any case treated since 1952. (BBB)

22554 FOLLOW-UP STUDY OF PATIENTS TREATED BY X-RAY FOR TINEA CAPITIS. Albert, Roy E.; Omran, Abdel R.; Brauer, Earle W.; Dove, David C.; Cohen, Noel C.; Schmidt, Herbert; Baumring, Ralph; Morrill, Sonia; Schulz, Robert; Baer, Rudolf L. (New York Univ., N. Y.). Amer. J. Public Health, 56: 2114-20(Dec. 1966).

The nature and magnitude of chronic radiation injury due to x-ray epilation were evaluated by a follow-up study of 1908 cases of tinea capitis (ringworm of scalp) who were treated by x-ray-induced epilation and 1801 cases of tinea capitis who did not receive x-ray therapy. Both groups were treated between 1940 and

1958. The x-ray epilation technique involved exposure of 5 overlapping areas of the scalp to the x-ray beam to irradiate the scalp as uniformly as possible. The air dose from the 100-kV unfiltered beam for each field was 350 R. Dosimetric studies of this irradiation technique, using a head phantom built around the skull of a 7-yr-old child, indicated that the dose to the scalp ranged from 500 to 800 rad and that the surface dose to the brain was 140 rad. In each group 14 cases died during the period of follow-up. In the irradiated group, 3 died of leukemia, 1 of aplastic anemia, 5 from violent causes, and 5 from other diseases. In the controls, no deaths occurred from leukemia or aplastic anemia. In addition to the 3 leukemia deaths there were 6 cases of cancer for a total of 9 cases in the irradiated group. Of these cancers, 4 were in the head (2 brain tumors, 1 fibrosarcoma of the mandible, and 1 lymphosarcoma of a submandibular gland). There was also a case of Hodgkin's disease and a case of rectal cancer. In the nonirradiated cases there was only 1 cancer, a case of Hodgkin's disease. The number of cases of mental illness, including psychosis, personality disorders, and psychoneurosis was higher in the irradiated group (45) than in the nonirradiated controls (13). Twenty-three percent of the irradiated individuals showed generalized loss of hair over the entire surface of the scalp compared to 0.7% in the nonirradiated group. There were 23 irradiated cases with cysts and nevi of the scalp compared to 5 cases in the controls. In the audiometric examinations the irradiated cases showed an elevated incidence of high-frequency hearing loss. Studies of chromosomal abnormalities in the peripheral blood suggested a higher incidence of stable and unstable forms of chromosomal aberrations in the irradiated group compared to the controls. (BBB)

22555 THYROID NODULES AFTER RADIOACTIVE FALLOUT. Lancet, 2: 580-1(Sept. 10, 1966).

The incidence of thyroid pathology is compared in 3 groups of children: children on Rongelap Atoll in the Marshall Islands exposed to radioactive fallout accidentally in 1954, children treated with ^{131}I for hyperthyroidism, and children who received x radiation for thymus enlargement. The population of Rongelap examined had received a radioiodine dose of about 150 rad to adult thyroids and about 1000 rad to children's thyroids. The glands received an additional 175 rad from external γ radiation. There were 13 cases of nodular thyroids in an exposed population of 29 children up to 10 yr of age at the time of exposure, and 3 cases aged 29, 30, and 34 yr at the time of exposure. Two other children exposed in infancy, were retarded in growth and development as a result of hypothyroidism. Strikingly similar morphological findings of thyroid replacement by very numerous nodules of varied microscopic appearances, without increase in thyroid weight, were reported in American children who had been given therapeutic ^{131}I on account of primary hyperthyroidism. Of a total of 6 treated children under the age of 10 yr, 4 developed nodular thyroids 7 to 13 yr later. Another group of 2809 infants was given thymic x radiation. The latest follow-up has revealed 14 thyroid carcinomas and 27 adenomatous thyroids; there were no carcinomas and 2 adenomas in 4329 unirradiated control sibs. The average dose of thyroid x radiation was 600 rad in the children who developed thyroid cancer, 370 rad in those who developed thyroid adenomas, and 220 rad in the group as a whole (less than the 1000 rad received by the thyroids of the Rongelap children). The results suggest that the postirradiation development of a solitary thyroid nodule or of a multinodular gland may be correlated with radiation dose. (BBB)

22556 THE POSSIBILITY OF ACCELERATING THE EXCRETION OF MERCURIAL DIURETICS LABELED WITH ^{203}Hg USED IN RADIOISOTOPE SCANNING OF THE KIDNEY. Cardinale, A.; De Simone, G. F. (Univ., Palermo, Italy). Med. Nucl. Radiobiol. Lat., 9: 147-70(1966). (In Italian).

The use of mercurial diuretics labeled with ^{203}Hg in radioisotope scanning of the kidney has given rise to certain questions in connection with radioprotection. A report is given of a study of the values of the biological period of the ^{203}Hg in the kidney and of the doses to which the kidney is exposed, and further of a series of experimental studies of the methods and preparations that have been proposed with a view to accelerating the excretion of the ^{203}Hg by the kidney thereby decreasing the dose absorbed by the organ. The methods that have been proposed and tested are subdivided into physical, physico-biological, biological and pharmacological methods. It could be concluded from the findings that certain substances in the compound-forming category (cysteamine, cystein, thioctic acid) are capable or bringing about a rapid excretion of the ^{203}Hg and do not cause toxic phenomena or other side effects. (auth)

22557 HEMATOLOGICAL MODIFICATIONS FOLLOWING EXPOSURE TO RADIATION. PATHOLOGY AND TREATMENT. Nuvolone, U. (Istituto Radiologico, Novara, Italy). Med. Nucl. Radiobiol. Lat., 9: 241-78(1966). (In Italian).

This communication consists of two parts. In the first part, the hematological physiopathology of the irradiated organism is discussed with separate reference to the various forms of leukopenia, of anemia and of thrombocytopenia. A number of hypotheses concerned with the possible pathogenic mechanisms are considered. A whole chapter is devoted to the various forms of human radioleukemia. The second part is concerned with the medical treatment of the various forms of cytopenia due to irradiation. In brief paragraphs the drugs currently used are listed, with brief notes on their pharmacology. (100 references.) (auth)

22558 PREOPERATIVE RADIATION FOR ADVANCED MALIGNANT TUMORS. Herbst, Walter E.; Cooley, Robert N.; Ozarda, Ahsen T. (Univ. of Texas Medical Branch, Galveston). Amer. J. Med. Sci., 252: 603-18(Nov. 1966).

Some theoretical aspects of the use of preoperative radiation are reviewed, and experimental evidence concerning the reduction in size of the primary tumor, incidence of local recurrences, and dissemination and distant metastases is cited. The experiments outlined show an immediate and striking inhibitory effect following medium-sized and small doses of radiation on the capacity or potentiality of tumors to grow after they have been artificially disseminated. This effect can usually be detected within a few hours and begins to disappear within a week or two. If a similar effect occurs in human tumors, it would lead to a different and little explored concept in the clinical use of preoperative radiation. Hitherto the predominant concept has been that doses approaching the lethal or curative levels must be used to achieve any worthwhile effect. The delivery of these doses, usually by fractionation, has greatly prolonged the treatment period and in some instances may have produced undesirable complications and has discouraged the widespread use of preoperative radiation. Some clinical evidence suggests that smaller radiation doses given over a short period of time may be followed by a significant improvement in resectability of the tumor and survival rate. The use of preoperative therapy in cancer of the corpus uteri, breast, esophagus, lung, rectum, and ovary and also in mixed tumors of the kidney and osteogenic sarcoma is reviewed. (BBB)

22559 RADIOTHERAPEUTIC RESPONSE OF PRIMARY LUNG CARCINOMA ACCORDING TO CELL TYPE. Silbiger, Martin L.; Lott, Stewart (Johns Hopkins Hospital, Baltimore). Bull. Johns Hopkins Hosp., 119: 283-7(Oct. 1966).

Radiosensitivity of various histologic types of lung carcinoma was studied on the basis of survival time following radiotherapy as the only treatment given. The 105 cases were treated by 250-kv or 2-MeV x rays to total doses of 4155 to 4450 R fractionated 30 to 32 days. There was a distinct difference as to rapidity of spread of disease and survival time, between anaplastic lesions on the one hand and squamous cell and adenocarcinomas on the other. Patients with undifferentiated or anaplastic carcinomas developed distant metastases more quickly than those with squamous cell or adenocarcinoma, and patients with oat cell carcinoma had the shortest median survival time. Survival studies of the effect of radiotherapy in primary lung carcinoma differ in their conclusions as to its effectiveness, some have indicating prolongation of life while others suggesting that, particularly when supervoltage radiation is used, significant improvement in survival is obtained, with tumor sterilization being achieved in a small proportion of the cases. When the survival data for treated primary lung carcinoma were compared with that for an untreated series, a slightly longer median survival was apparent in the treated group in all histologic types. (BBB)

22560 DEVELOPMENT OF OSTEOGENIC SARCOMA IN A RADIUM DIAL PAINTER THIRTY-SEVEN YEARS AFTER THE END OF EXPOSURE. Woodard, H. Q.; Higinbotham, Norman L. (Sloan-Kettering Inst., New York). Amer. J. Med., 32: 96-102 (Jan. 1962).

A case of radiation-induced osteogenic sarcoma is reported in a 55-yr-old woman who had ingested radioactive paint between the ages of 16 and 18 yr. Autoradiography of the bones of the amputated leg showed that Ra was still concentrated at the sites of the former epiphyseal plates. The first sarcoma originated at one such site, and microscopic evidence of early sarcoma was found in at least one other. The patient's total terminal body burden was about 0.8 μC of Ra. The accumulated dose in different microscopic areas of bone was estimated to range from 1400 to 88,000 rad. There was roentgenographic evidence of radiation changes in almost the entire skeleton, but the patient had had few symptoms prior to the development of sarcoma. The patient's peripheral blood showed no evidence of radiation damage to the marrow, the blood cell counts being normal. Alkaline phosphatase activities of bone specimens were higher than in normal adult spongiosa, probably reflecting the unusually active proliferation which was taking place. (BBB)

22561 SEQUELAE OF IRRADIATION FOR BENIGN CONDITIONS. Cannon, B.; Murray, J. E. (Massachusetts General Hospital, Boston). pp 122-6 of Trans. 3rd Intern. Congr. Plastic Surg., Oct. 13-18, 1963, Washington, D. C. Amsterdam, Exerpta Medica Foundation, 1964.

This report considers 165 earlier cases and 46 new ones with relation to the incidence, seriousness, and sequelae of exposure to irradiation for benign conditions. In each, surgical treatment was performed or recommended for the disabling sequelae. Most of the new cases (38) are the result of treatment more than 5 yr ago. However, there were 8 patients exposed since that time, 5 of whom sought surgical advice less than one year after the exposure. The interval from exposure to treatment of sequelae averaged 21 yr. The spectrum of benign primary conditions for which x-ray treatment is given has changed significantly. Now acne infection is the indication in most patients, totaling 15, whereas plantar wart, by far the most frequent in the earlier report, was the initial lesion in only 11. The third most common condition was angioma treated in infancy (9). Only 3 professional personnel required surgical treatment in marked contrast to the 28 reported previously. The average time lapse from exposure to surgical treatment in plantar wart with its associated abnormal skin was 5.5 yr. That for epilation or angioma with normal skin took 20 yr. The current incidence of proven carcinoma was 42%, compared with 22% incidence reported 5 yr ago. Of the 19 patients with carcinoma, 18 were on the face and proved to be basal cell or basal-squamous carcinomas. The average interval from the initial treatment by x ray until carcinoma was proven in the damaged area was 26 yr. This is similar to the 28-yr interval reported previously. This report draws attention to the disfiguring, painful, disabling, malignant, or life-endangering sequelae which may occur sooner or later following x-ray exposure for benign conditions. (BBB)

22562 SELECTION OF PATIENTS FOR ^{131}I TREATMENT. Tubiana, M. (Institut Gustave Roussy, Villejuif, France). Panminerva Med., 7: 450-4(Nov. 1965).

Possible hazards of ^{131}I therapy of hyperthyroidism are discussed in relation to choosing patients for treatment who may be considered in low risk groups. The principal hazards considered are those of genetic injury, carcinogenesis, leukemogenesis, and fetal damage during treatment in early pregnancy. The dose to the gonads is about 1 to 2 rad per mC, or 10 to 20 rad total for the treatment of hyperthyroidism. The genetic risk to the descendants of a patient as well as the risk to the population is considered. In considering the population as a whole, it is possible to calculate an average dose to the gonads. For example, if 5000 patients were treated per yr and each received 10 mC, and if the gonad dose for each individual is 1 rad/mC, the cumulative dose to the gonads of the treated patients would be 50,000 rad/yr. In 30 years, or about one generation, this would amount to 1.5 Mrad. For a population of 50 million the average increment to the gonadal dose attributable to radiation treatment would therefore be 0.03 rad for this period. If the probability of mutation is 0.005/rad/infant, among 1 million newborns there will be 150 additional mutations. This figure is small compared with 60,000 spontaneous genetic defects. If it is accepted that a dose of 50 rad doubles the frequency of spontaneous leukemia during the 15 yr following the treatment, about 50 to 100 additional cases of leukemia would arise per 100,000 patients having received this dose. On this basis, the risk arising from treatment by radioiodine which delivers 10 to 20 rad to the bone marrow, that is, a dose between $\frac{1}{5}$ and $\frac{1}{3}$ the doubling dose, would be very small, less than 5 in 10,000 patients. Pregnancy is an absolute contraindication to the use of radioiodine. It presents a risk of destroying the thyroid of a fetus older than 3 months. Furthermore, at the beginning of gestation the embryo is very radiosensitive. Since radioactive iodine passes into the milk lactation also presents an absolute contraindication. (BBB)

22563 THE PROBLEM OF OSTEORADIONECROSIS FOLLOWING IRRADIATION OF FEMALE GENITAL TUMORS. Fochem, K. (Univ., Vienna). Wien. Klin. Wochenschr., 77: 802-4 (Oct. 22, 1965). (In German).

The characteristic incidence of fractures of the head of the femur induced by x irradiation for female genital tumors was studied in 19 patients. The average age of the patients was 60.7 yr. Out of the 19, four patients had radiologically detectable arterioscleroses. In 16 patients who had received 3 series of irradiations totalling 16,000 R, one fracture appeared after 3 yr, 10 fractures appeared after 2 yr, 2 after $1\frac{1}{2}$ yr, and 3 after 1 yr. In 3 patients who had received one irradiation series of 8,000 to 10,000 R, one fracture appeared after 2 yr, and 2 appeared after 1 yr. All 19 patients exhibited stage II or III skin changes, 4 being stage II, and 15 stage III. Of the 19 women, 15 were markedly adipose. The conclusions that the author drew from this study were that most of the fractures appeared within 1 to 2 yr after the conclusion of irradiation. It was not possible to correlate the other observations of the patients' conditions and physical states with the appearance of the femoral fractures. (BBB)

22564 RADIOTHERAPY. Smithers, D. W. Trans. Med. Soc. London, 81: 20-7(1965).

Fundamental aspects of radiation effects on normal and tumor cells are presented, and the concepts discussed are illustrated by clinical results of radiotherapy in diverse situations. The scientific basis of radiotherapy rests on radiation physics and radiobiology. With modern equipment it is now possible to give high doses at any point in the human body with considerable accuracy, and to state in fairly precise terms what has been done, that is, how much energy has been absorbed in erg/g by the tissue concerned. The main physical difficulty limiting the radiation effect on the tumor is the problem of concentrating the energy absorbed in the volume of tissue needing treatment. Alteration in the microscopic distribution of the energy absorption in tissues (linear energy transfer, LET) through the use of heavy particle radiation (neutrons, protons, π-mesons) may advance biological effectiveness, but the accuracy of dose distribution possible with the apparatus now available is already ahead of the radiotherapist's skill in defining the volume to be treated for all but the most accessible tumors. Also discussed are some aspects of tumor growth-rate and dose response, using some tumors in young people for illustration; some technical points in treatment planning, using carcinoma of the bronchus for illustration; some ideas about tumor localization and the assessment of results, using testicular tumors for illustration; and the possibilities presented by ideal situations, using well-differentiated thyroid carcinoma for illustration. (BBB)

22565 CECAL MASS DUE TO THE INTRAPERITONEAL INJECTION OF RADIOACTIVE ZIRCONIUM PHOSPHATE. Wilson, Edward Austral. New Zeal. J. Surg., 35: 237-8(Feb. 1966).

A case of benign tumor formation from injection of a ^{32}P compound, with apparent radioinduced changes in the tissue, is reported. The 57-yr-old woman had been treated with the radioisotope 6 months previously for prevention of a cancer recurrence. She had received a prophylactic injection into the peritoneal cavity of radioactive colloidal zirconium phosphate. Thereafter, she had an occasional pain in the right iliac fossa and in the epigastrium, and within a few months she also complained of the passage of blood per rectum. A hard, slightly tender, fixed mass in the right iliac fossa, about 5 cm in dia was found. Microscopical examination of the surgically removed mass with the cecum and ileocecal valve showed chronic ulceration, dense vascular fibrosis, blood vessel thickening containing lipid, capillary proliferation with some perivascular lymphocytes, and foamy changes in ganglion cells. These changes were interpreted as a result of irradiation. No evidence of malignancy was found. The dose of radioactive zirconium phosphate injected in this patient was 10 mC and was contained in 100 ml of normal saline. Some localization of the injected fluid could have occurred in the region of the cecum, thus producing a high dose of β irradiation locally. The histological findings are in keeping with this, and no other cause of the lesion was found. (BBB)

22566 BLADDER COMPLICATIONS AFTER SURGICAL INTERVENTION AND IRRADIATION AT THE LEVEL OF THE PELVIS. Weyeneth, R. Helv. Chir. Acta, 33: 492-7(Aug. 1966). (In French).

Several cases of radionecrosis of the bladder after radium therapy for cervical cancer are reported. A survey of the histories showed that cystoscopic diagnosis of this lesion was not always simple, especially when a growing tumor mass was also present in the bladder. Cystitis was classified as acute or chronic. In the acute type, symptoms appeared within 1 day to 6 weeks and resembled those of ordinary cystitis. An interval of 10 to 12 yr sometimes intervened before development of the chronic type. The first endoscopic sign was circumscribed telangiectasia, which later developed into a submucosal hemorrhage and then an ulcer. Infection, with necrosis and possibly lithiasis as a later development, sometimes occurred. In some cases, the ulcer developed into vesicovaginal fistula. (BBB)

22567 IRRADIATION AND OTOSCLEROSIS: HISTOLOGICAL STUDIES. Jorgensen, M, Balslev; Kristensen, H. I. (Rigshospitalet, Copenhagen). Ann. Otol. Rhinol. Laryngol., 75: 677-87(Sept. 1966).

Histologic investigation of temporal bones from 165 patients showed a definite etiologic relation between irradiation and otosclerosis. The case histories and histologic findings in 4 patients are reported. Case 1 developed severe otosclerosis in both ears immediately after 3900 R irradiation. Case 2, which had received a dose of 2400 R to the right ear 11 months before death, showed otosclerosis on the irradiated side and not on the other. Case 3 showed bilateral otosclerosis 14 yr after 1650 R irradiation.

Case 4 had an otosclerotic focus of moderate activity on one side immediately after a radiation dose of 790 R to both ears. Thus, in Cases 1, 2, and 3 there was a definite relation between the side affected by otosclerosis, the activity of the focus, and radiotherapy. A review of temporal bone data for 165 patients over one year of age revealed that 4 more had received radiation of the skull for cerebral tumors, but in no case with the beam hitting the labyrinth. None of these 4 patients showed histological signs of otosclerosis. Pathogenic possibilities are considered including a direct irradiation-induced activation of dormant embryonic tissue, an accelerative effect upon a microscopic focus present already, or a process of repair in the labyrinthine capsule, caused by a radiation-induced aseptic necrosis of bone. (BBB)

22568 COMPARISON OF RESULTS OF TREATMENT OF CARCINOMA OF THE LOWER LIP BY A METHOD USING SUPERFICIAL APPLICATOR AND A METHOD OF INTERSTITIAL APPLICATION. Danczak, Zofia; Leszczyk, Czeslawa (Instytutu Onkologii, Warsaw). Nowotwory, 15: 257-63(July-Sept. 1965). (In Polish).

A comparison was made of the effectiveness of and the complications resulting from the use of Ra for treatment of carcinoma of the lower lip by two methods: one with a superficial applicator and an interstitial method with vertical and transverse insertion of the needles. Comparative studies were made of topical results, duration of the postirradiation reaction, frequency of therapeutic complications, and amount of Ra used. The series consisted of 171 cases treated by the interstitial method (117 with vertical application, and 54 with transverse) and 97 patients treated by the superficial applicator. All patients were under observation at least 5 yr. The best results were obtained with application of Ra by the interstitial method with transverse position of the needles; no local recurrence was observed and it was found that the course of postirradiation reaction was shortest and most mild and that posttherapeutic complications were least frequent. The amount of Ra applied averaged 15 times less by this method than by superficial application. The physician is exposed to about 14.4 and the nurse 28 times as much γ radiation by the superficial type treatment because of the large amount of Ra required. (BBB)

22569 RADIOINDUCED MANDIBULAR NECROSIS CASES WHICH DEVELOPED SUDDENLY FOLLOWING SIMPLE DENTAL TREATMENTS. 4th REPORT. Kobayashi, Ichiro, Miyamoto, Kazuya; Takagi, Haruhiro; Murakami, Hiroshi; Nagaoka, Kihaku; Kuroda, Sechuo (Kanazawa National Hospital, Japan). Shika Gakuho, 63: 606-10(Aug. 1963). (In Japanese).

Whenever the mandible is subjected to high dosage radiotherapy, there is the possibility that subsequent dental procedures may contribute to the development of osteoradionecrosis. Four cases of mandibular necrosis are described which developed as a result of simple dental treatments in previously irradiated patients. These patients had received cancerocidal doses of telecobalt γ therapy or Ra implantation for treatment of malignant oral tumors. One to 7 yr postirradiation they were treated by dentists for caries, pyorrhea, or denture fitting, reasons entirely unrelated to the antecedent malignancy. Osteoradionecrosis developed presumably because of radiation exposure of bone during these dental treatments. Aseptic necrosis of irradiated bone is not followed by healing processes and new tissue formation. It is therefore recommended that carious teeth be extracted before rather than after radiotherapy in the oral cavity. Close supervision and cooperation of dentists and radiotherapists are advised in such cases. (BBB)

22570 RESULTS OF RADIOIODINE THERAPY IN MALIGNANT THYROID TUMORS WITH SPECIAL REFERENCE TO HORMONE THERAPY. Pabst, H. W.; Frey, K. W.; Strohm, C.; Heinze, H. G. (Institut und Poliklinik fuer Physikalische Therapie, Munich). Verhandl. Deut. Ges. Inn. Med., 70: 908-12(1964). (In German).

Hormone treatment is an important extension of ^{131}I radiotherapy for thyroid tumors. It serves not only to ensure metabolism after thyroid extirpation, but it is also effective for tumors that have the ability to respond to altered thyrotropic hormone stimulation. If, after therapeutic removal of the thyroid, the cholesterol values are associated with a euthyroid condition, this suggests the presence of metastases whose functional capacity has developed only because of increased thyreotropic stimulation following thyroid extirpation. Hormone therapy should be regulated on the basis of clinical symptoms and is based primarily on the measured serum cholesterol values. In one group of patients with differentiated adenocarcinoma without hormone therapy, 13% were alive after 3 to 5 yr. In a similar group that received hormone therapy, 59% lived longer than 3 yr, and 12% longer than 5 yr. (BBB)

22571 ROLE OF SCINTILLATION SCANNING IN CLINICAL MEDICINE. PART III. Freeman, Leonard M.; Schneider, Joel A.; Kay, Chester J.; Zingesser, Lawrence H.; Zimmerman, Charles (Albert Einstein Coll. of Medicine, Bronx, N. Y.). N. Y. State J. Med., 66: 2257-65(Sept. 1, 1966).

Use of radioisotopes for kidney, pancreas, and bone scanning is reviewed, with a discussion of the advantages and disadvantages of various isotopes, and the patient doses encountered with each. The use of ^{203}Hg-chlormerodrin for renal scintiscanning has gained wide acceptance. Although ^{203}Hg has a physical half-life of 45.7 days, the chlormerodrin is excreted with an effective half-life of only 8 hr. About 66% is recoverable in the urine in 24 hr. From the usual dose of 100 μC, the kidney gets a radiation exposure of 20 to 30 rad while the whole body dose is 0.1 to 0.2 rad. With ^{197}Hg-chlormerodrin, because of the short physical half-life of 2.6 days, low-energy γ emissions of 68 to 78 keV, and the absence of any β emission, it is a more suitable agent dosimetrically for kidney scanning. The usual dose, 125 to 150 μC, delivers only 0.5 to 1 rad to the kidney and the negligible amount of 2 to 8 mrad to the whole body. The use of ^{75}Se-selenomethionine for pancreas scintiscanning offers the only direct measurement of pancreatic morphology other than exploratory laparotomy. Selenium-75 has a physical half-life of 128 days and a biologic half-life of 33 days, with a principal γ-ray energy of 0.279 MeV. The total-body dose after the standard scanning dose of 3 μC/kg is 0.9 to 1.3 rad, with an additional 0.06 rad to the pancreas and 0.05 rad to the liver. No adverse reactions to ^{75}Se-selenomethionine have been reported. Strontium-85 nitrate is the agent most commonly used for bone scanning. Its 64-day half-life allows for a long shelf-life, and its monoenergetic γ photon of 513 keV is fairly radially collimated. For a standard dose of 100 μC the internal exposure to the patient's whole body is 0.6 rad, and the max bone dose is between 1.6 and 4.6 rad. (BBB)

22572 ROLE OF SCINTILLATION SCANNING IN CLINICAL MEDICINE. PART II. Freeman, Leonard M.; Schneider, Joel A.; Kay, Chester J.; Zingesser, Lawrence H.; Zimmerman, Charles (Albert Einstein Coll. of Medicine, Bronx, N. Y.). N. Y. State J. Med., 66: 2129-49(Aug. 15, 1966).

Use of γ-emitting radioisotopes for thyroid, liver, and spleen scanning is reviewed, with attention to choice of isotopes, doses, and the hazards involved. Iodine-131 has become the most widely used isotope for thyroid scanning, but scanning with ^{123}I is advocated, since gland exposure dosage will be reduced by 15%, largely because there are less energetic emissions from the isotope. Technetium-99m (as pertechnetate) can be used as a thyroid scanning agent since its metabolism is similar to that of ^{131}I. Major advantages stem from its low-energy γ photon, absence of short-range particle emission, and short half-life (6 hr). As a result, 1 mC or 20 times the usual ^{131}I dose may be administered with a thyroid exposure dose of only 100 mrad or 1/1000 that of ^{131}I. Total-body exposure is reduced by $\frac{1}{7}$. Scanning can begin 30 min after intravenous injection of this isotope compound. When scanned in the usual way with ^{131}I, an adult thyroid gland receives an exposure dose of 50 to 100 rad during physical and biologic decay of the isotope, largely because of short-range energetic β particles. Total-body dose, related to longer-range γ photons, is only 50 mrad or 1/1000 of thyroid exposure. Such dose levels appear to present little if any danger to an adult. However, maternal ingestion of ^{131}I after the third month of pregnancy will result in fetal thyroid concentration of the isotope and a gland dose of about 5 times that of an adult. Furthermore, in infants, because of high relative concentrations in a smaller tissue mass, gland irradiation may be 25 times that of the adult, and there is a possibility of radiation injury. Thyroid scans are rarely performed after early pregnancy or in infants unless urgent indications are present. Smaller isotope doses and more sensitive detectors should then be used. For liver scanning, ^{198}Au and rose bengal labeled with ^{131}I are the most popular. Radiogold is picked up rapidly by the Kupffer cells of the liver and is retained in these cells. It has a short half-life (2.7 days) and most of the dose it delivers is from its β activity. The whole-body dose is about 0.54 mrad/μC injected, and the dose to the liver from a scan is about 7 rad. (BBB)

22573 CONTRIBUTION TO POSTOPERATIVE IRRADIATION OF MAMMARY CARCINOMA. Wilkening, Kurt (Zentralroentgeninstitut der Staedtischen Krankenanstalten, Bremen, Ger.). Strahlentherapie, 127: 27-38(May 1965). (In German).

A total of 725 patients was irradiated with ^{60}Co at an average interval of 5.7 weeks after surgery for removal of mammary carcinoma. None was irradiated more than 3 months after surgery. The irradiations were given within 18 days, 6 times weekly. At the conclusion of the irradiation the skin was slightly reddened, and infrequently showed epitheliolysis. Small changes in pigmentation and some teleangiectases appeared after several years. Nausea was present in only 10% of the cases treated. Focal doses amounted to 3000 to 4000 R, given tangentially. The average survival time of 107 of the patients who were in Stage IV was 18.5 months. Of these, 66 were irradiated for bone metastases, 14 for

skin metastases, 8 for lymph node metastases. Three-yr survival times averaged 67.8%, and were 82.4%, 57.4%, and 28% for patients in Stages I, II, and III, respectively. Corresponding five-yr survival times averaged 55.2%, and were 75.2%, 43.3%, and 10%. In 5% of the patients reactions of the pleura and lungs were observed. Radiation pneumonia was observed 6 times as frequently in patients who were irradiated both pre- and postoperatively with 3000 R each. Recovery was spontaneous, and in only 12 cases were fibrotic scars observed. Bone necroses were not observed. Edema of the arms that appears later than ½ yr after surgery should be suspected as a lymph node metastasis. (BBB)

22574 CLINICAL EXPERIENCES IN TREATMENT OF PATIENTS WITH FAR-ADVANCED MALIGNANT NEOPLASMS UTILIZING RADIOACTIVE MICROSPHERES. Perry, John F. Jr. (St. Paul-Ramsey Hospital, St. Paul, Minn.). Progr. Clin. Cancer, 2: 193-8(1966).

Clinical results and complications from the use of ^{90}Y microspheres in 37 patients are described. Complications ranging in severity from dermatitis to pancytopenia occurred in 11 patients. Two patients developed pancytopenia. Microspheres from the batch used to treat one of these patients showed a 10% elution rate of ^{90}Y due to a defect in preparation; the acceptable level is 0.5%. Rigid controls to eliminate this problem were established, and subsequently no systemic complications have been observed. Local complications included dermatitis, peripheral neuritis, perforation of gastric carcinoma, gastric ulcer, rectovesical fistula, necrosis of pulmonary parenchyma and cerebral cortex, cerebral edema, and hemiparesis. Perforation of an inoperable gastric carcinoma occurred 2 months after infusion of microspheres into the left gastric artery. Autopsy 4 months after treatment of a lung cancer demonstrated necrosis and an area of necrotic lung, probably due to deposition of a high concentration of microspheres in a small region of the lung. Autopsy of 2 patients treated for brain cancer demonstrated necrosis of an extensive posterior fossa astrocytoma and of the surrounding brain tissue in one; in the second, there was destroyed tumor and edema of the brain. Two patients with far-advanced carcinoma of the tongue treated by lingual artery injection developed hemiparesis. Proximal occlusion of the lingual artery during injection is mandatory to avoid retrograde passage of spheres to the internal carotid artery. A rectovesical fistula followed treatment of one prostatic carcinoma by direct injection of microspheres. Gastric ulcer with exsanguinating hemorrhage followed hepatic irradiation in one patient. Thirty-four of the 37 patients have died, and 3 are living. One appears to be free of cancer; the second has shown dramatic regression of carcinoma of the tongue, but residual cancer is present in the neck. (BBB)

22575 MEAN EUTHYROID 24-HOUR RADIOIODINE UPTAKE AS A CHARACTERISTIC OF DIFFERENT PATIENT POPULATIONS. Oddie, T. H.; Fisher, D. A. (Univ. of Arkansas, Little Rock). J. Clin. Endocrinol. Metab., 27: 11-14(Jan. 1967).

Equations are given for the conversion of the 24-hr thyroidal uptake of ^{131}I by unmedicated erthyroid subjects to its equivalent fractional thyroidal clearance rate. Data for several different patient populations were analyzed and compared. In most cases the equivalent thyroid clearance values showed a log-normal distribution. (C.H.)

22576 CERVICAL LYMPH FLOW IN MAN FOLLOWING RADIATION AND SURGERY. Fisch, Ugo P. (Univ., Zurich). Trans. Amer. Acad. Ophthalmol. Otolaryngol., 69: 846-68 (Sept.-Oct. 1965).

The normal pattern of cervical lymph flow was studied, as well as the changes observed in the lymphatic circulation of the neck following radiotherapy and surgery on the basis of 154 cervical lymphograms. The lymphographic findings were correlated with histologic study of corresponding specimens removed at surgery after lymphography. Both conventional x radiation and ^{60}Co γ radiation were used to deliver average doses of 7000 R to lymph nodes of the neck. The observed decrease in size and number of lymph vessels and nodes was roughly proportional to the dose of radiation. No qualitative difference was seen between the effect of conventional x rays and γ rays. The deeper cervical lymph nodes and vessels seemed to be more affected after the use of ^{60}Co radiation. Complete block to retroauricularly injected contrast agents was never found following irradiation. Histological findings indicated that the changes observed after irradiation were probably secondary to postirradiation changes of the connective tissue. (BBB)

22577 RADIOTHERAPY FOR CARCINOMA OF THE BLADDER. Crigler, Cecil M.; Miller, Lowell S.; Guinn, Gene A.; Schillaci, Harold G. (Anderson Hospital, Houston, Tex.). J. Urol., 96: 55-61(July 1966).

Complications of radiotherapy are reported for a series of 352 cases of carcinoma of the bladder treated with 22-MeV x rays or ^{60}Co γ rays. Major complications occurred in 13% of the 352 patients treated. The complication rate during the first 3 yr was 24%. Of the total of 47 major complications, 18 were fatal, a mortality rate of 5%. Of the 18 fatalities, 14 involved the upper urinary tract. Because of changes in treatment policy and in the correction factors used for calibration, and because of a change in dose specification from roentgens to rads, doses prior to 1959 were low. From 1954 through 1958, only 13% of the external beam patients received doses of 5750 rad or more; from 1959 through 1962, however, this figure rose to 70%. Arguments have been presented against classifying as complications those instances of pyelonephritis and uremia which appear to have been precipitated and/or aggravated by irradiation. Seven fatal kidney complications observed were in this group, but at least the remaining 40 major complications were considered dose-related. With or without the upper urinary tract complications, however, present experience with megavoltage irradiation has been less catastrophic than that reported earlier. It is suggested that the worst local complications after radiotherapy are those due to persisting local cancer. After irradiation, the intravesical surface of persisting tumor is usually necrotic. There is a tendency to assume that this necrosis is always a complication of irradiation. Triiodothyronine was administered to 17 patients in an attempt to halt bleeding from "radiation cystitis," only to have uncontrolled tumor later demonstrated in 12 of these. If, therefore, the bladder mucosa is unhealed 3 months after the end of radiation, it is better to risk deep biopsy (and possible further delay in healing of the few genuine radionecroses) than to risk loss of the only real remaining chance to save the lives of most such patients with definitive treatment (usually total cystectomy). (BBB)

22578 SURGICAL MANAGEMENT OF EXTENSIVE NECROSIS AFTER RADIATION THERAPY. Bennett, J. E.; Carter, D. (Ohio State Univ., Columbus). pp 131-21 of Trans. 3rd Intern. Congr. Plastic Surg., Oct. 13-18, 1963, Washington, D. C. Amsterdam, Exerpta Medica Foundation, 1964.

A description is given of plastic surgical procedures performed on 20 patients with severe radionecrosis. Of the remaining cases there were 6 with head or neck involvement, 3 with ulcerations of the upper trunk, 2 with marked changes in the anterior abdominal wall, and 1 with an acute radiation ulcer of the arm. The indication for operation in each instance was pain and/or ulceration. Successful management of these lesions required adequate excision of the damaged area and replacement with fat-bearing pedicle flap tissue. When adjacent flaps are used, permanent blood supply to the region is assured. Careful preoperative planning, meticulous operative technique, and diligent postoperative care were essential for treatment to be successful and morbidity kept at a minimum. Free skin grafting either was unsuccessful or was deemed inadvisable in these cases. While early excision and grafting is theoretically ideal, it is not always practical. Malignant changes were not found in the cases described but this can be attributed to the relatively short interval between radiation therapy and surgical treatment of the radionecrosis (8 to 15 yr). Several serious complications are discussed including partial flap necrosis and postoperative infection. It is suggested that previous reports on this subject have not given sufficient emphasis to the need for full thickness, fat-bearing, permanently vascularized pedicle flap tissue as replacement for radiation-damaged tissue. (BBB)

22579 GAMMAENCEPHALOGRAPHY AS A METHOD OF CHECKING ON IRRADIATION OF BRAIN TUMORS. Voutilainen, A.; Pihkanen, T. (Univ., Helsinki). Ann. Med. Internae Fenn., 43: 143-8(1965).

The effect of large doses of radiation, directed to brain tumors, on blood flow in the irradiated area was studied with ^{131}I-labeled human serum albumin and ^{203}Hg-Neohydrin. The 53 patients studied had received ^{60}Co or electron radiation. Such gammaencephalography performed before and after radical irradiation indicated whether the uptake of radioisotope decreased or increased in the irradiated area of the brain. Also examined was whether the clinical picture and scanning findings were in correlation. The study revealed that prior to irradiation brain tumors could be located by scanning in 90% of histologically verified cases. The patient's clinical picture and radioisotope scanning were compatible and correlated in 80% of this group, and if clinically diagnosed brain tumors and brain metastases were included, correlation was found in 73% of all the cases. It is recommended that isotope scanning of the brain be made a part of follow-up examination, since such examination can be performed on nonhospitalized patients and the more complicated arteriographic examinations can be avoided. (BBB)

22580 WILMS' TUMOR METASTATIC TO THE LUNG: REPORT OF A SURVIVOR WITH RADIATION THERAPY ONLY. Poznanski, Andrew K.; Bloor, Robert J. (Henry Ford Hospital, Detroit). Henry Ford Hosp. Med. Bull., 14: 161-6(June 1966).

A rare case of eradication of metastatic tumor by radiotherapy, with survival of the patient, and development of radioinduced pneumonia are reported. With most neoplasms the presence of pulmonary metastases means uncontrollable disease. However, in some radiosensitive tumors such as Wilms' irradiation therapy can produce a cure. The patient described is alive and well more than 5 yr after irradiation of bilateral pulmonary metastases from Wilms' tumor. The 2½-yr-old patient was originally treated preoperatively with a tumor dose of 1600 R in 1½ weeks. A right nephrectomy was performed 2 weeks later, Wilms' tumor being found on pathologic examination. After the operation the patient received radiation therapy in the area of the kidney, with a total tumor dose of 3200 R. Chest x-ray films made 2 months postoperatively showed pulmonary metastases which became extensive 1 month later. The right lung was treated with 200-kV x rays with a tumor dosage of 666 R in 1 week. The subsequent week the left lung was treated to a similar dose. The lungs were treated alternately until each lung received a tumor dose of about 2000 R over 6 weeks. White count determinations showed the lowest value one month after the beginning of radiotherapy, when the count was 2400. Radiation therapy was completed 5 months after the operation. Two and one-half months after beginning of radiation therapy the patient developed temperature elevations up to 102°F. Wheezes were heard in the lung fields, and chest x ray showed opacities in the perihilar areas as well as an infiltrative process was seen in the left lower lobe. The patient was placed on antibiotic therapy. The symptoms, which finally cleared, were attributed to postirradiation pneumonitis. (BBB)

22581 PREOPERATIVE IRRADIATION AND SURGERY IN HEAD AND NECK CANCERS. Ogura, Joseph H. (Washington Univ., St. Louis). J. Kentucky State Med. Ass., 64: 35-6(Jan. 1966).

The concept of low-dose irradiation combined with radical surgery is based on a biologic concept that the incidence of failure due to recrudescence could be reduced significantly without the added risk of surgical complication. In animal experiments the author, using a moderately aggressive tumor implanted in mice, demonstrated significant improvement in survival of such animals by preoperative low-dose irradiation and surgery compared to a series with no treatment, low dose irradiation, or surgery alone. In this animal series, a dose of 500 rad, obviously insufficient to cure the cancer, inactivated 95% of the biologic activity of the cells, and then surgery was 85% successful as compared to 50% when surgery alone was employed, 1% when only irradiation was used, and no survivals with no treatment. Clinical studies in 250 cases are also reported. Radiation doses of 2000 to 3000 rad were given over two weeks and the patient operated upon in the third or fourth week. There was an absence of skin reaction or mucositis at the time of operation. There was an overall 14% local recurrence rate compared to a 40% recurrence rate without preoperative irradiation therapy. The use of low-dose preoperative x ray and surgery caused some complications. There was a delay in healing by several days, and with each increment of 1000 rad there was a further time delay in healing. (BBB)

22582 PHAGOCYTIC ACTIVITY OF LEUKOCYTES IN INDOLENT EROSIONS AND NEOPLASTIC PROCESSES OF THE UTERINE CERVIX AND ITS CHANGES UNDER THE INFLUENCE OF RADIUM THERAPY. Mardakhiashvili, Sh. I.; Taronishvili, R. S. Akusherstvo Ginekol., 40: 87-92(July-Aug. 1964). (In Russian).

Phagocytic activity of leukocytes was studied in 46 patients, 22 of which suffered from nonhealing cervical lesions and 24 from malignant tumors of the uterine cervix. For comparison, 14 healthy women were studied during the same period. Eleven of the patients received intracavitary ^{60}Co or radium-mesothorium at intervals of 3 to 4 days, with a total dose of 4000 to 9500 R. In 9 patients this radiation treatment was combined with external x irradiation in a dose of 9000 to 20,000 R. The phagocytic activity of leukocytes was noticeably inhibited in precancerous hyperplasia and malignant tumors of the uterine cervix. Radium therapy of patients with malignant tumors of the uterine cervix stimulated the phagocytic activity of leukocytes only temporarily at the beginning of treatment (1000 to 2000 R) and during (4000 to 6000 R) the treatment, but at the end of treatment depressed it, especially sharply when intracavitary radium therapy was combined with external x irradiation. Leukopenia caused by ionizing radiation is not always accompanied by a lowering of phagocytic activity of leucocytes; therefore, it is important to examine the phagocytic activity during radium therapy to evaluate leukocyte function. (BBB)

22583 RADIATION THERAPY OF LYMPHOGRANULOMATOSIS. zum Winkel, Karl (Univ., Heidelberg). Med. Klin. (Munich), 60: 1903-9(Nov. 19, 1965). (In German).

The treatment of Hodgkin's disease should be local initially. Postoperative or later treatment with ionizing radiation is indicated. A thorough radiological diagnosis of the thoracic and retroperitoneal spaces should be made prior to each irradiation series. The purposes of this procedure are the detection of lymph node metastases and complications in the internal organs. Foci located superficially are irradiated most advantageously with high-energy electrons; interstitially located foci should be treated with γ radiation from ^{137}Cs or ^{60}Co. Megavolt therapy is superior to x irradiation because of its protection of the skin and healthy tissues. Lymph node involvements in the pelvic and retroperitoneal spaces are susceptible to localized irradiation by means of ^{131}I-lipiodol. More serious generalized symptoms require blood transfusions and administration of glucocorticoids. Simultaneous treatment with radiation and cytostatic agents is seldom necessary, but these should be given alternately. Only when growth is generalized are cytostatic drugs indicated. Although the exact amount of irradiation to be administered always should be suited exactly as possible to the individual case, usually a focal dose of 4000 R, administered over a period of 3 to 4 weeks should be given. (BBB)

22584 QUANTITATIVE STUDIES ON ERYTHEMA. Sayre, Robert M.; Olson, Robert L.; Everett, Mark Allen (Univ. of Oklahoma Medical Center, Oklahoma City). J. Invest. Dermatol., 46: 240-4(Mar. 1966).

During the course of a study of uv-induced erythema, much quantitative data were accumulated characterizing the normal range of response. The relation among different uv wavelengths in the erythema range also was studied by administering combinations of suberythemal quantities at several wavelengths. Erythema action spectra were determined on 30 young adult Caucasian subjects, using the min quantity of uv light necessary to produce erythema at the following wavelengths: 250, 254, 260, 270, 280, 290, 297, 300, and 310 mμ. Monochromatic uv light was administered to 1-cm^2 test areas on the abdomen of each subject. The data obtained in each experiment are tabulated, and the aggregate mean minimal erythema doses (MED's), standard deviations, and medians are given. The mean MED's are expressed in both μW-sec/cm^2 and photons/cm^2. A plot of mean MED and one standard deviation vs wavelength is also illustrated. In general, the values obtained were consistent with those few data previously reported. No significant differences in response could be related to age, sex, hair color, eye color, or complexion. The variation in response of a single individual at different times was nearly as large as the variation in response of different individuals. The validity of the so-called addition theorem as applied to uv-induced erythema was demonstrated. (BBB)

22585 DYNAMIC CLINICAL STUDIES WITH RADIOISOTOPES AND THE SCINTILLATION CAMERA: I. SODIUM IODOHIPPURATE-^{131}I RENOGRAPHY. Burke, Gerald; Halko, Arlene; Coe, Fredric L. (Michael Reese Hospital, Chicago). J. Amer. Med. Ass., 197: 15-24(July 4, 1966).

The use of the scintillation camera for dynamic studies of renal function with sodium ^{131}I-iodohippurate (Hippuran) is described. This approach permitted constant visual monitoring of the passage of ^{131}I-iodohippurate through the parenchyma and pelvis of the kidney concomitant with the inscription of the renogram curve. It thus permitted more definitive interpretation of the renogram since it allowed direct, rather than intuitive, correlation of the various segments of the renogram curve with the intrarenal location and transit of ^{131}I-iodohippurate at that time. Several variations and abnormalities of renogram contour were characterized in this manner. The results indicated that scintillation-camera renography may be a useful adjunct in the evaluation of renal function under both clinical and experimental conditions. (BBB)

22586 RADIOISOTOPE RENAL STUDIES AND RENAL HYPERTENSION: A COMPARISON OF THE SODIUM IODOHIPPURATE-^{131}I RENOGRAM, CHLORMERODRIN-^{197}Hg UPTAKE, AND RENAL SCAN. Meier, Donald A. (Naval Hospital, Chelsea, Mass.); Beierwaltes, William H. J. Amer. Med. Ass., 198: 1257-62(Dec. 19, 1966).

The diagnostic efficiency of the sodium iodohippurate-^{131}I renogram in detecting renal hypertension was found to be ineffective as a screening test for the detection of renal disease as a cause of hypertension because false-negative results were found in 29% of patients proved at operation to have ischemic renal lesions. The principal cause for this deficiency was too wide a range of normal values for the principal quantitative parameters used in the analysis of the test. A new technique was, therefore, used in 11 normal controls and 26 hypertensive patients were studied during a one-year period. The patients were hydrated and underwent iodohippurate-^{131}I renograms and chlormerodrin-^{197}Hg renograms and renal scans. Results of the isotope studies were compared with those of intravenous pyelography, aortography, split renalfunction studies, and surgery. At least one radioisotope test was positive in all 13 patients with unilateral renal disease. The diagnostic accuracy of each test was 62% for the iodohippurate-^{131}I renogram,

92% for the chlormerodrin-^{197}Hg renogram, and 85% for the renal scan. (BBB)

22587 SCANNING AND IRRADIATION OF THE LIVER WITH RADIOISOTOPES. Ackerman, Norman B. (Boston Univ.). Amer. J. Surg., 112: 263-7(Sept. 1966).

Clinical and experimental studies on the use of ^{32}P, ^{198}Au, and ^{90}Y to irradiate neoplasms in the liver are reported, in addition to experiments on scintillation scanning of liver with various γ-emitting isotopes. For radioisotopic irradiation the choice of isotope depends on the type of ionizing emission, energy, and biologic and physical half life, and especially the relative concentration of the isotope in the tissue to be irradiated. Since few radioisotopic compounds are selectively concentrated by the tumor, it is necessary to use agents that are concentrated by normal liver tissue. Rose bengal-^{131}I is selectively taken up by the liver, but it is so rapidly excreted that an effective radiation dose is not built up. Thus, radioisotopic substances that are cleared from the blood by the reticuloendothelial system or physically trapped in the precapillary vessels, must be used. These materials include radioactive colloidal particles, such as ^{32}P-tagged colloidal chromic phosphate and colloidal ^{198}Au and tagged insoluble plastic, glass, or ceramic microspheres labeled with ^{90}Y. Experimental and clinical studies with microspheres labeled with ^{90}Y, showed they can be delivered to the liver by injection into the hepatic artery or by injection into the portal system via a mesenteric vein. Some patients with liver metastases received symptomatic relief, and in some a decrease in the liver mass was noted. However, since 80% of radioactivity from ^{90}Y penetrates only up to 5 mm, effective radiation of all but the smallest tumors is dependent on an adequate blood supply of the tumor. Thus, the treatment is, at best, palliative. Radiocolloids and tagged microspheres may prove more valuable in the prevention of metastases than in the treatment of established tumors. Reasons are given for preferring ^{32}P-labeled colloidal chromic phosphate over colloidal ^{198}Au. The radiation energy from ^{32}P is greater and the physical half life is longer. Furthermore, the absence of γ radiation from ^{32}P makes it safer to use in patients receiving therapeutic doses. When colloidal chromic phosphate is administered intravenously, 80 to 90% of the dose is concentrated in the liver. Only 2 to 15% is taken up by the spleen, and there is no problem of bone marrow damage. Experimental studies in rats injected with 100,000 cells of Novikoff hepatoma into the portal vein system, followed by an intravenous injection of 75 μC of colloidal chromic phosphate-^{32}P, which delivered about 3000 rad to the liver are described. When the ^{32}P was administered 1 min after the tumor cells, the incidence of tumors developing in the liver decreased to less than half. Later studies with an increased radiation dose confirmed the beneficial effect of this technic. (BBB)

22588 CANCER OF THE LUNG: RECOGNITION AND MANAGEMENT. Ochsner, Alton Jr.; Ochsner, Alton (Ochsner Clinic, New Orleans). Surg. Clin. N. Amer., 46: 1411-25(Dec. 1966).

The radiotherapy of lung cancer, radiosensitivity of various types of tumor, and side-effects caused by irradiation are reviewed. In general, highly undifferentiated and oat cell cancers are the most radiosensitive and the adrenocarcinomas the least radiosensitive. The lung, however, is less tolerant of irradiation than many other organs of the body where epithelial cancers are highly radiocurable. The value of preoperative or postoperative irradiation is controversial. Irradiation can be used to shrink a large mass or control hilar metastases before resection of the tumor. In the case of Pancoast's tumor, the value of preoperative irradiation is established and has converted this previously incurable type of bronchogenic cancer into a potentially curable tumor. Some studies suggest that preoperative mediastinal irradiation in all patients with bronchogenic cancer may increase resectability and cure rates, but postoperative complications are more frequent in these patients. For preoperative irradiation a subcancerocidal dose (3000 rad) is recommended as it seems to prevent dissemination of neoplastic cells and decreases the viability of cells circulating or spilled, without increase in the radioinduced or surgical morbidity. Routine mediastinal irradiation after pulmonary resection has not statistically improved the survival rate of patients with bronchogenic cancer. Postoperative irradiation, however, appears to be beneficial when the primary tumor involves the adjacent pleural surfaces (chest wall or aorta), without evidence of nodal metastasis. (BBB)

22589 RADIOSENSITIZATION OF ESCHERICHIA COLI BY METHYL HYDRAZINE AND THE EFFECT OF OXYGEN. Moroson, H.; Martin, D. (Sloan-Kettering Inst. for Cancer Research, New York). Nature, 214: 304-6(Apr. 15, 1967).

During studies of bacterial radiosensitisation it was found that methyl hydrazine sensitised E. coli to radiation inactivation. Although this is a new type of sensitiser, it shared some features common to other sensitisers in that it was nontoxic to bacteria at concentrations of 10^{-2} molar or less; it must be present during irradiation; and it was more effective under anoxic than under oxygenated irradiation conditions. The principal chemical features of this agent were its basicity, reducing ability, and water solubility. It was not a radiosensitiser for all strains of bacteria. Results were reported for several strains of E. coli irradiated under anoxic and aerobic conditions. In a separate investigation it was found that methyl hydrazine also sensitised mice to whole-body radiation lethality. It was suggested that the use of cell radiosensitisers may be of value in radiation therapy of tumour cells, especially those more radioresistant because of anoxia. (UK)

22590 CONTRIBUTION OF THE TREATMENT OF POST-IRRADIATION CYSTITIS, PROCTITIS, AND COLPITIS. Ledr, J. Cesk. Gynekol., 30: 575-8(Oct. 1965). (In Czech).

A new method of treatment of postirradiation proctitis, cystitis, colpitis, and dermatitis with the pyrimidine drug 6-methyluracil is described. The drug was used as suppositories (0.1 g) introduced into the vagina or rectum 3 to 5 times a day in cases of colpitis, cystitis, and proctitis. It was also used as a jelly (1½% of the drug suspended in 2% water solution of tragacanth with 1½% benzocaine) for instillation into urinary bladder or rectal ampulla in cystitis or proctitis. Or it could be used as a 10% ointment in cases of dermatitis. In 9 patients tested, healing was achieved in both the inflammatory and ulcerated forms of radioinduced intestinal, genitourinary, or dermatologic lesions induced by radiation. (BBB)

22591 THOROTRAST TUMORS OF THE KIDNEY. THREE ADDITIONAL CASES. Dunant, J. H.; Rutishauser, G. (Univ., Basel). Schweiz. Med. Wochschr., 96: 1156-60(Sept. 10, 1966). (In German).

The number of surviving persons who are estimated to have retained ThO_2 after its use as a contrast medium are between 50,000 and 100,000. The reported frequency of ThO_2 tumors in these persons is from 5,000 to 10,000, with an average latency time for kidney tumors of 23.9 yr. Since ThO_2 was given even during the 1950's additional cases of these tumors can be expected to continue to appear. Since 1949, 19 tumors of the kidney following ThO_2 retrograde pyelography have been reported. Three cases are described and diagnosis and treatment are discussed. It is pointed out that the presence of a tumor should always be suspected if untoward symptoms are observed in the urinary tracts of patients who have ThO_2 deposited in the kidneys. If unilateral ThO_2 deposition is detected in a kidney that has stopped functioning, nephrectomy is indicated. (BBB)

22592 PREOPERATIVE IRRADIATION FOR BRONCHOGENIC CARCINOMA. Karlson, Karl E.; Washor, Harry (State Univ. of New York, Brooklyn). Progr. Clin. Cancer, 2: 164-71(1966).

Clinical results and complications of irradiation before surgical resection of lung cancer are examined, first by a literature survey, then by reports from a small series of patients. In one series of patients treated with ^{60}Co teletherapy (4000 to 4500 R to all tumor-bearing areas plus an additional 1500 to 2000 R to the primary lesion and the adjacent mediastinal lymph nodes) resection was attempted two months later. Irradiation was well tolerated, the operative technic did not prove more difficult than without preoperative irradiation, a significant number of patients were rendered resectable by the irradiation, and a high percentage of the mediastinal lymph nodes was sterilized by irradiation. The survival rate was increased. However, in most series of cases reported, preoperative irradiation appeared to be associated with an increased postoperative morbidity. The evidence accumulated to date indicates that preoperative irradiation is of value in superior sulcus syndrome carcinomas only. There is no evidence that preoperative irradiation improves the results of surgery for other carcinomas of the lung. (BBB)

22593 ON THE OPTIMIZING OF X-RAY QUANTA ENERGY IN X-RAY DIAGNOSIS. Rohloff, F.; Eck, G. (Kernforschungsanlage, Juelich, Ger.). Elektromedizin, 10: 153-8(July 1965). (In German).

The statistical distribution of the x-ray quanta that form the image limits the perceptibility of contrast. The ratio of the statistically resolvable contrast gradient to the dose used is defined as the dose contrast threshold value. At low energies, lower than about 30 keV because of the high absorption at the dose used, the effective degree of contrast is very small. As the energy increases the absorption decreases, so that the dose also decreases. Tube voltages between 100 and 160 kV give optimal results because of the more homogeneous dose burden on the object. This becomes particularly important at higher voltages where the energy absorption in bone, bone marrow, and hematopoietic cells is markedly reduced. There is only a slight dropoff in degree of contrast effect at very high voltages, while at the lower voltage range below the max the degree of contrast effect falls off within a few kV by

several orders of magnitude. Greater sensitivities of the photographic system can be obtained at higher quanta energies when the x-ray quanta patterns are transformed into visible pictures. In order to be able to use the optimal degree of contrast effect for reduction of the dose burden in x-ray diagnosis it is necessary to develop x-ray sensitive films and screens that have maximum response in an energy range above 50 keV up to about 80 keV. (BBB)

22594 SOME THEORETICAL PROBLEMS OF THE EQUIPMENT FOR THE DETERMINATION OF RADIOACTIVITY DISTRIBUTION IN LIVING ORGANS. Lokajicek, Milos. Jad. Energ., 12: 429-31(Nov. 1966). (In Czech).

The article deals with some theoretical problems of the determination of optimum parameters of an equipment used in diagnostics for activity distribution determinations in living organs. The basic parameters of scanning systems and their dependencies on various conditions are derived. (auth)

22595 DIFFUSION MECHANISM OF THE RADIOPROTECTIVE ACTION OF NITROGEN UNDER PRESSURE. Paribok, V. P.; Kalney, Valentina S. (Inst. of Cytology, Leningrad). Radiat. Bot., 7: 97-105(Apr. 1967).

The radioprotective effect of compressed nitrogen (20 atm) added to air is decreased when respiration of bean seedlings is reduced by cold treatment (+2°C), by the action of KCN or by cupferron. The effect is not observed when NO is used as a radiosensitizer instead of air. These data contradict the adsorption hypothesis of the protective effect of inert gases and nitrogen at elevated pressure. A diffusion hypothesis is suggested: compressed gases prevent oxygen from diffusing into intracellular spaces of the root and thus to the meristematic cells. Experiments on the infiltration of seedlings showed that the vertical routes of oxygen diffusion (from the cotyledons towards the roots) are most important. In the light of this hypothesis the data on the protective action of compressed gases on other biological materials are discussed. (auth)

22596 RELATIONSHIP BETWEEN OXYGEN TENSION IN TISSUES AND THE PROTECTIVE ACTION OF PARA-AMINOPROPIOPHENONE AND OF PROPYLENE GLYCOL. Vacek, A.; Sugahara, T. (Kyoto Univ.). Proc. Soc. Exp. Biol. Med., 124: 356-9(Feb. 1967).

Intraperitoneal injection into mice of 4-amino-propiophenone (PAPP) resulted in a decreased oxygen tension in tissues; and 90% of the decrease was reached within 15 to 20 minutes after injection. The course and the extent of the decrease in oxygen tension after PAPP injection was the same when 0.9% NaCl or 50% propylene glycol (PG) was used as a vehicle. Oxygen tension in tissue was decreased after injection of PG (50%). The inhalation of pure oxygen at 1 atm pressure, after injection of PAPP, caused an increase of O_2 tension in tissues when 0.9% NaCl was used as a vehicle; however, when PG or PAPP in PG was injected, only slight elevation of oxygen tension was observed. The mortality data are related to the changes of oxygen tension in tissues. (auth)

22597 ABSORPTION, DEPOSITION, AND EXCRETION OF ^{89}Sr BY THE CHICK IN RELATION TO ROUTE OF ADMINISTRATION. Creger, C. R.; Colvin, L. B.; Couch, J. R. (Texas A and M Univ., College Station). Proc. Soc. Exp. Biol. Med., 124: 445-8(Feb. 1967).

The maximum concentration of ^{89}Sr observed in chick blood following an oral dose was observed to occur in about 2 hours and decreased to a negligible quantity in 24 hours. The rate of uptake of ^{89}Sr by chick bone was found to parallel the rate of increase in activity of the blood, but the former continued to increase to 14 hours post-injection time. The eyes took up radiostrontium in a similar way, but in much lower concentrations. It was observed that the most efficient excretion was accomplished when the isotope was ingested orally, and the least efficient elimination was observed when the isotope was administered by intraperitoneal injection. All routes of administration, except the oral route, resulted in higher activity in the urine than in the feces with the highest urinary excretion occurring as a result of intramuscular injection. (auth)

22598 METHOD OF IMPROVING THE SIGNAL-TO-NOISE RATIO IN NUCLEAR-MEDICINE DIAGNOSIS. Beck, H. (Siemens-Schuckertwerke AG, Erlangen, Ger.). Atompraxis, 13: 85-7(Feb. 1967). (In German).

One of the problems of diagnosis in nuclear medicine is the small signal-to-noise ratio caused by the statistics of decay and by small activities. A method of phase-correct accumulation is described to ameliorate the ratio if the signal is periodic. (auth)

22599 IMPORTANCE FOR RADIOPROTECTIVE EFFECT IN MAMMALS OF PHARMACOLOGICAL AND BIOCHEMICAL ACTIONS OF CYSTEAMINE AND RELATED SUBSTANCES. Bacq, Z. M. (Univ., Liege); Beaumariage, M. L.; Van Canegham, P.; Ciccarone, P. Ann. Ist. Super. Sanita, 1: 639-45(1965).

A general working hypothesis for the action mechanism in mammalian radioprotection is advanced. First, a binding of the protector to cell and membrane proteins occurs. This then alters the permeability of the membranes of isolated liver mitochondria and induces a swelling. This swelling effect is correlated with radioprotective effect of SH or S-S protectors and is believed to occur in vivo in good time correlation with radioprotection. These mitochondrial alterations upset carbohydrate metabolism. This hypothesis is termed biochemical shock. (C.O.)

22600 THRESHOLD OF ERYTHEMA SKIN REACTION TO UV IRRADIATION IN NEUROSES. Gruenner, O. (Czechoslovak State Spa, Jesenik). Activ. Nerv. Super., 8: 219(1966).

The erythema threshold of uv irradiation was determined in 131 patients (228 examinations) using the same uv source. The examinations were carried out in the winter months in neurotic patients the second day after arrival at and on the 21st day of treatment upon leaving the hospital. On the basis of experience with healthy subjects a 3-min dose was considered as the control value. The appearance of erythema after a 5-min irradiation (hyporeactivity) or in the first min of irradiation (hyperreactive skin response) was classified as a pathological value. If erythema failed to appear after a 5-min irradiation, this was classified as skin areactivity. The incidence of pathological values of the erythema dose increased with increasing intensity of neurotic symptoms. (BBB)

22601 ON TWO UNCOMMON CASES OF NEOPLASMS ARISING AFTER RADIOTHERAPY. Celleghin, F.; Girardi, G. F.; Lauro, R. (Ospedale Civile, Padua). Acta Chir. Ital., 21: 543-57(July-Aug. 1965). (In Italian).

Two cases are described in which x ray therapy for carcinoma was believed to have caused subsequent development of sarcomas. Possible mechanisms of carcinogenesis by ionizing radiations are reviewed, as are previous cases of radiocarcinogenesis reported in the medical literature. In the first case reported here, a spindle cell carcinoma which had been found on the skin of the right calf of a 42-yr-old man had been subjected to 14 doses of x ray therapy for a total of 6700 R. Six months later an ulcer formed at the treatment site, and a biopsy taken 15 months postirradiation revealed a peritheliomatous sarcoma. The second case concerned a 10-month-old girl born with a cavernous hemangioma on the lower thorax. At the age of 2 months it was treated with a total dose of 700 R in one series and two months later with 300 R. At 7 months of age the hemangioma had diminished in size. Three months later the mass increased markedly in size. After surgical removal of the mass, histologic examination showed the presence of a fibrosarcoma. Reasons are given for attributing the development of these two sarcomas to the antecedent radiotherapy. (BBB)

22602 PREVENTION AND THERAPY OF EFFECTS OF IONIZING RADIATION. Cairella, Michelangelo; Soccorsi, Franco (Univ., Rome). Clin. Terap., 31: 154-69(Oct. 31, 1964). (In Italian).

After a review of the effects of ionizing radiations on biological structures, various means for prophylaxis and treatment of radiation injuries are surveyed. The principal effects considered include hematopoietic tissue injury, leukemogenesis, changes in membrane and other tissue barriers, and genetic changes. Use of various chemical agents as radioprotectants, such as cysteamine and AET, and their possible modes of action are discussed. Criteria are presented for diagnosis of radiation sickness and the severity of symptoms at various exposure levels is mentioned. Treatment of radiation disease by hematopoietic replacement, antibiotics, fluids, vitamins, minerals, and specific agents to increase radionuclide elimination is outlined. Prevention of contamination from fallout radionuclides and decontamination measures are explained. The extent of the hazard from close fallout from thermonuclear explosions is evaluated and examples are given of the radiation doses that would be received under various conditions. (BBB)

22603 LEUKEMIA FOLLOWING RADIOIODINE THERAPY OF HYPERTHYROIDISM. Werner, Sidney C. (Columbia Univ., New York); Gittelsohn, Alan M.; Brill, A. Bertrand. J. Amer. Med. Ass., 177: 646-8(Sept. 2, 1961).

Data collected by questionnaire from 60 clinics in the United States revealed 10 leukemia cases among 32,000 ^{131}I-treated thyrotoxicosis patients followed for 142,000 person-yr. The actual and expected incidence is tabulated for the various types of leukemia by age and sex. The 10 cases observed are contrasted with 13.8 cases expected. There were significantly fewer chronic cases than expected (3 as opposed to 9 expected). For males there was a significant excess of acute cases (6 to 1), while for females there was a significant deficit of total cases (2 to 10)

and of chronic cases (1 to 6). The findings are consistent with under-reporting of cases after ^{131}I therapy and heightened male susceptibility. Acute granulocytic leukemia is generally the form of leukemia most increased in adults after exposure to whole-body, external, ionizing radiation, but in the Japanese atomic bomb survivors, the incidences of chronic granulocytic leukemia and of acute lymphocytic leukemia (in childhood) were also markedly increased. Despite the deficit of chronic leukemia in the present data, the preponderance of acute leukemia, with the observed skewness in sex distribution, does not rule out the possibility that there may be an increased risk of leukemia following ^{131}I therapy. (BBB)

22604 THORIUM X IN THE TREATMENT OF NEVUS FLAMMEUS. Mohajerin, Amir H. (Medical Arts Bld., Regina, Can.). Acta Dermato-Venereol., 46: 186-9(1966).

Hazards and complications of treatment are considered with reference to the results of Th X therapy in 39 cases of nevus flammeus treated over a 25-yr period. Thorium X was used in lacquer form containing 450 μCi (3000 esu) per ml at the time of application. The lacquer was applied to the lesion with a metal applicator and a second coat was applied 15 min after the first. It was allowed to remain on the lesions from 24 to 72 hr, then removed with acetone. Treatments were given at intervals of 2 to 4 months over a period of 1 to 4 yr. Despite claims by many authors that no serious or permanent damage occurs in therapy with Th X, moderate radiation effects and permanent damage are possible in the use of any radioactive material, and Th is no exception. Radiation dangers with Th X therapy applied near the genital organs of children are appreciable. Especially for hemangiomas, because of the length and frequency of the treatment, the radiation load on the gonads may be considerable. In some instances treatment of dermatological lesions with Th X is more of a risk than an advantage to the patient and should not be used. Minor complications after treatment of the skin with Th X are reviewed. The α particles of Th X bombarding the skin from the surface are capable of producing erythema and pigmentation. The hyperpigmentation is caused by the increased functional activity of melanocytes and not by an increase in their number. Transient erythema, pigmentation, and vesication may occur, as well as glossiness or marbling effects of the skin. Questionable atrophy and absence of lanugo hairs have been reported in one case after 81 painting. In the author's series no severe complications occurred although 9 of the patients developed transient erythema after each application of the material. Treatment of nevus flammeus with Th X probably produces fewer complications than other methods of radiotherapy, such as with grenz rays. (BBB)

22605 PITUITARY ABLATION BY ^{90}Y IMPLANTS FOR DIABETIC RETINOPATHY. Fraser, Russell; Joplin, G. J.; Steiner, R. E. (Postgraduate Medical School, London). Diabetes, 11: 482-3(Nov.-Dec. 1962).

When complete ablation of the pituitary is desired, ^{90}Y is the best radioisotope because of its intense but localized β radiation. The irradiation planned must deliver over 100,000 rad to the whole pituitary gland, giving the diaphragm as small a dose as is compatible with this, and avoiding more than 10,000 rad to any nerve, including the optic nerve and chiasm which is potentially the nearest. With slight errors in placement, the diaphragm may be necrosed and cerebrospinal fluid may escape into the sella, with consequent rhinorrhea. The risk of complications in radioisotope implantation is small, considering the severe disease involved and even when the general state of the patient is poor. The main risk from ^{90}Y implantation, rhinorrhea, varies in incidence from 5 to 10% and is treatable by screw insertion. In the 11 cases reported, rhinorrhea occurred in three patients. Of the three, two have stopped, one spontaneously and one after screw insertion. The third patient died of hypoglycemia soon after the resolution of meningitis whose onset revealed the rhinorrhea. No other complications were encountered. (BBB)

22606 SCANNING WITH POSITRON-EMITTING ISOTOPES IN CEREBROVASCULAR DISEASE. Ojemann, Robert G.; Aronow, Saul; Sweet, William H. (Massachusetts General Hospital, Boston). Acta Radiol., Diagn., 5: 894-905(1966).

The use of ^{74}As as sodium arsenate and ^{64}Cu chelated with DTPA (diethylenetriaminepentacetic acid) for detection of brain lesions is described. Localization with positron-emitting radioisotopes utilizes the peculiar physical properties of the positron-electron annihilation process. This reaction yields a pair of oppositely directed γ rays that are recorded when they hit a pair of detectors in time coincidence. This record, called a positrocephalogram (PCG), as well as the difference in total γ activity between one side of the head and the other, may be obtained. This unbalance scan, or asymmetrogrammagram (AGG), indicates the asymmetry of a concentration of activity which is right or left sided. The two scans, PCG and AGG, are printed simultaneously by mechanical printers directly connected to the moving detector heads, so that a full-sized lateral picture is immediately available. Radioisotopic scans utilizing ^{74}As were abnormal in most patients having a neurologic deficit and subarachnoid hemorrhage from an aneurysm. All hypertensive intracranial hemorrhages were localized with ^{74}As during the second and third weeks after onset. Permanent neurologic deficit associated with cerebral infarction due to thrombotic occlusion usually produced an abnormal arsenic scan during the first 4 weeks after onset. Transient ischemic attacks or temporary neurologic deficit usually yielded normal scans. All scans of embolism were negative. The ^{64}Cu chelate showed a much lower percentage of abnormal isotopic concentration than ^{74}As. (BBB)

22607 FAILURE OF SHIELDING THE THYMUS TO INDUCE RECOVERY OF BONE MARROW AFTER RADIATION. Adams, D. (Dental School, Cardiff). Acta Haematol., 37: 109-19 (1967).

Thymic potential to repopulate the bone marrow after irradiation was examined. A lethal dose of irradiation was used to provide the maximal stimulus, at the same time excluding the problems of immune reaction and transplantation difficulties by shielding the thymus during irradiation. Guinea pigs were irradiated (^{60}Co) with a lethal dose of 400 R. Irradiated control animals lost weight and none survived beyond 12 days. On the other hand the thymus-shielded animals gained weight up to the time of sacrifice. Thymuses of the controls showed a marked loss in weight compared with the experimental animals, though the percentage of cells taking up the thymidine-^{3}H was the same. From a determination of DNA in the bone marrow an estimate of the number of cells/mg was made, as well as an analysis of the types of cells present. The initial drop in the number of cells was comparable for the two groups of animals. After five days, however, the recovery of the shielded animals was apparent, although the pattern of damage and recovery varied between the different types of cell. The granulocytic precursors took longer to reach minimum numbers than either the erythroid or the lymphoid types, while the recovery of the latter two types occurred earlier than in the granulocytic cells. The reticular cells here appeared to be radioresistant and did not take up thymidine. In other experiments on animals thymectomized before irradiation, it appeared that the thymus did not contribute anything to the recovery seen in the first experiments. A third series with shielded exteriorized thymuses was undertaken to exclude the possibility that some factor from the thymus might play a part in the bone marrow recovery when other elements were not involved. In attempts to explain the beneficial effect of shielding the neck region, the possible sources of the protective agent were considered. It was likely that some lymph nodes in the neck were shielded and an even more likely origin of the factors that caused repopulation of the bone marrow was the hemopoietic tissue in the myeloid spaces of the vertebrae. No evidence was obtained to suggest that a cell-free product of the thymus would aid hematopoietic recovery, as has been found in the spleen. It was concluded that thymus cells do not contribute to bone marrow cellularity after irradiation. (BBB)

22608 CONTRIBUTION TO THE STUDY OF THE ACTION EXERTED BY X RAYS ON THE RESISTANCE OF MICE TO EXPERIMENTAL INFECTION. Benes, S.; Mihaiesco-Nigrim, Maria; Turcanu, Al. G.; Cioranesco, Sanda (Centrul de Radiobiologie si Biologie Moleculara, Bucharest). Arch. Roum. Pathol. Exp. Microbiol., 23: 689-700(Sept. 1964). (In French).

Whole-body exposure of mice to a single dose of 450 R of x radiation resulted in a death rate of 51.1% 30 days following irradiation. Most animals died within the first 15 days. As compared with controls, irradiated animals displayed increased susceptibility to moderate experimental infection, 24 hr after irradiation, with an attenuated strain of Salmonella enteritidis. The susceptibility of irradiated mice to severe experimental infection with 10 $LD_{100/15}$ of S. enteritidis 15 days after irradiation was similar to that recorded in normal mice. Irradiation performed one day before vaccination with the attenuated strain of S. enteritidis did not abolish the protection conferred by this vaccination against experimental infection with the virulent homologous strain 14 days after vaccination. However, the degree of protection was significantly reduced. Cell-free mouse spleen homogenate proved to be markedly toxic when associated with the attenuated strain, or alone, above a certain dose. The rate of survival among irradiated animals revealed that cell-free spleen extract exerted a protective action, in contrast to cell-free homogenate, which did not protect the animals against the effects of irradiation. Irradiated animals treated with homogenate resisted experimental infection with 10 $LD_{100/15}$ of S. enteritidis 15 days after exposure in a sig-

nificantly higher proportion than animals treated or not treated with extract. (BBB)

22609 RESULTS OF HYPOPHYSECTOMY WITH RADIOACTIVE GOLD AND ^{90}Y. Wense, G.; Zaengl, A. Bull. Soc. Int. Chir., 23: 81-6(Jan.-Feb. 1964). (In German).

Out of 133 operations on 125 patients where ^{90}Y was used for hypophysectomy in cases of mammary carcinoma, prostate cancer, tumors of the stomach, cardia, uterus, ovary, rectum, thorax, mediastinum, etc., no visual disturbances were ever encountered in direct connection with the operation. In one patient there was optic nerve atrophy 6 months afterward, and at autopsy olfactory nerve atrophy was found also. Vision was also decreased in a second patient 6 months after the operation. In 13 patients a cerebrospinal fluid fistula occurred, 2 of which required surgical correction. The others healed within 3 to 6 weeks under antibiotic treatment. Of the 125 cases, 12 died just after the clinical procedures, but about the same number died prior to this treatment. The causes of death included pulmonary embolus, encephalomalacia, pneumonia, cachexia, and purulent leptomeningitis. Two general types of reaction were observed to result from ^{90}Y hypophysectomy. One was an immediate or early reaction, appearing within two days after the operation, when even the most persistently painful cases became free of pain. The other was freedom from pain and other symptoms which required several weeks to become fully effective. Even when the clinical symptoms were atypical, prolonged analgesia could be expected in a third of the cases. (BBB)

22610 THE EFFECT OF X RAYS ON THE SEBACEOUS GLAND IN THE GUINEA PIG AND MAN. Maggiora, A.; Bujard, E.; Jadassohn, W. (Univ., Geneva). Hautarzt, 16: 298-300(July 1965). (In German).

No changes in the sebaceous glands were observed until 20 days after whole-body x irradiation of guinea pigs with a single dose of 1600 R. By 30 days the glands were not visible, but 2 or 3 months after irradiation they were detectable again, and by 4 or 5 months they were larger than normal. In animals irradiated daily with 200 R for 8 days, no changes at all were observed in the sebaceous glands 30 days after irradiation. In two human patients irradiated in an area of the left ventral thorax with 300 R, no effects on the sebum secretion were observed in one, and a slight reduction was observed in the other. When the 300 R was fractionated into three 100 R doses given at weekly intervals to one of these patients in another field the sebaceous secretion was decreased 35 days after the first irradiation and remained decreased until 65 days. In the second patient, sebaceous secretion was reduced from 15 to 85 days after the irradiation. Thus, the fractionated irradiation had more effect than the single, larger irradiation to reduce the secretions of the sebaceous glands. These results may be reflected in the good results obtained by fractionated x irradiation treatment of acne vulgaris. These studies also illustrate differences in the responses of the sebaceous glands between the guinea pigs and humans that should be taken into account before using results of animal experiments as evidence for what may occur in humans. (BBB)

22611 PROBLEMS OF THE IRRADIATION OF TISSUE WITH NEUTRONS. Hacke, Juergen (Hahn-Meitner-Institut fuer Kernforschung, Berlin). Roentgenpraxis, 17: 211-19(Sept. 1964). (In German).

Radiation therapy is concerned with neutron sources because the advancing development of nuclear reactors and accelerators has made them important neutron sources. The author discusses the bases of the metabolic effects of neutrons in biological tissues and the results produced as a method of dose evaluation. An example of neutron capture therapy is presented. The experimental difficulties associated with the use of neutrons in place of x rays or γ rays are presented. Methods of production of free neutrons are outlined. The metabolic effects of neutrons are illustrated by means of elastic scattering and capture processes that may take place within tissue. Methods of calculation of tissue dose are presented, illustrated with relations between specific energy loss in an isolated tissue element as a function of neutron energy, and energy doses from 1-Mev neutrons and thermal neutrons in a tissue equivalent plate 30 cm thick as a function of depth. Depth dose curves in tissue equivalent material for neutrons and γ irradiation are compared, and differences in dose decrease with depth are illustrated. Principles underlying the use of neutron radiations in therapy are discussed briefly, and some of the difficulties associated with their use are outlined. Exact dose estimation and the need for suitable sources of high energy neutrons are two examples of the disadvantages encountered. (BBB)

22612 RADIOGENIC FRACTURES (AN EVALUATION OF CASE HISTORIES FROM THE ORTHOPAEDISCHE UNIVERSITAETSKLINIK IN LEIPZIG). Cerwenka, Wolfgang (Univ., Leipzig). Zentralbl. Chir., 90: 1998-2003(Sept. 11, 1965). (In German).

The author reviews and reports the incidence of osteoradionecroses in 27 irradiated patients. Osteoradionecrosis first appeared from 1 to 11 yr after massive doses of x irradiation and/or Ra treatment for various tumors. Although the amounts of irradiation previously administered are largely unreported, the few reported indicate that up to 5000 mg/hr of Ra and 8000 R of x irradiation were given. Of the total patients treated it was possible to use conservative procedures with 11, and the others were surgically treated. Previous studies have indicated that 6000 to 6500 R of x irradiation represents the tolerance dose for production of osteoradionecrosis, but lower doses of 2000 R have also been reported. Intermediate values between 3800 and 4300 R have also been suggested. Even though multiple fields are used to reduce the total irradiation effects from treatment of ovarian tumors, for instance, the bone-damaging dose frequently accumulates in the region of the neck of the femur. When the tolerance dose is exceeded, it becomes evident by injury of the osteoblasts, devascularization of the bone, and sclerosis of the bone marrow. (BBB)

22613 ON THE PROBLEM OF THE SYNTROPY OF LEUKEMIA AND CARCINOMA. Helbig, Werner; Voigt, Karl-Gerhard (Karl-Marx-Univ., Leipzig). Arch. Geschwulstforsch., 21: 213-20 (1963). (In German).

Several reports have indicated that the incidence of leukemia among radiologists is as high as 9 times more frequent than among other physicians. Sections taken from among one group of 100 children with acute leukemia, who had been treated with cytostatics, x rays, and adrenocortical hormones, showed six instances of atypical epithelium of the ileum, colon, or appendix, and two squamous cell metaplasias of the bronchi and bronchioles. Out of 7 patients who had carcinoma and leukemia simultaneously, 3 had been x irradiated and 2 had been implanted previously with Ra. All were over 50. Generally, the leukemia appeared 2 to 6 yr after the appearance of the carcinoma, but in some it seemed to appear at or before the time the accompanying carcinoma was first detected. Whether leukemia patients suffer from carcinomas more frequently than others is not certainly known, but it may be possible. Some reports indicate that the chances of a second tumor appearing in carcinoma patients are the same as the probability of one occurring in healthy persons. (103 references.) (BBB)

22614 TREATMENT OF HYPERTHYROIDISM WITH SODIUM IODIDE-^{131}I: A 16-YEAR EXPERIENCE. Nofal, Mohammed M.; Beierwaltes, William H.; Patno, Mary Ellen (Univ. Hospital, Ann Arbor, Mich.). J. Amer. Med. Ass., 197: 605-10(Aug. 22, 1966).

A large proportion of patients developed hypothyroidism as a complication of radioiodine therapy of Graves' disease. The incidence of hypothyroidism among 848 patients treated for hyperthyroidism with sodium iodide-^{131}I was compared with the incidence among 121 patients treated surgically for hyperthyroidism. Generally, an attempt was made to achieve an ^{131}I concentration in the thyroid gland of 185 μCi/g, for a total thyroid dose of 16,700 rad. About 50% of all patients received a total dose between 10 and 20 mCi; 22% received an initial dose of 10 to 11 mCi. During follow-up periods ranging from less than a year to 16 yr, at least 51% of those treated with ^{131}I and 28% of those surgically treated became hypothyroid. After the first year of follow-up study, the cumulative incidence of hypothyroidism increased 2.8% per yr in the group treated with the radioiodine and 1.7% in the group surgically treated. It is also estimated that within the first 10 yr after treatment, 70% of the group treated with ^{131}I and 43% of the group surgically treated will have become hypothyroid. In the patients treated with ^{131}I, the incidence of hypothyroidism in those without clinically detectable nodularity of the thyroid gland was higher than in those with nodular goiters. It is the authors' policy at present to calculate the dose for a given patient, as before, then to subtract 3 to 4 mCi from this calculated dose for young patients with recurrent Graves' disease who have had a previous surgical thyroidectomy, and 2 to 3 mCi for a young person with a small thyroid gland without clinically evident nodularity. (BBB)

22615 REPRODUCIBILITY OF THE INDICATOR-DILUTION METHOD USING ^{125}I IN HAEMODYNAMIC STUDIES. Hobbs, John T. (St. Mary's Hospital, London); Edwards, Edward A. J. Cardiov. Surg., 7: 34-9(Jan.-Feb. 1966).

Improved technics and instrumentation were used to measure femoral artery flow by the indicator-dilution method using radioiodinated serum albumin and Cholegrafin. Cardiac output curves were also obtained and from the results, total blood volume, circulation times, and limb blood volume were calculated. Iodine-125 was shown to have advantages over ^{131}I and a compact semi-automatic instrument was constructed to obtain the time-concentration curves. As a result of experience with ^{125}I a new version of the instrument was constructed which is simple to use and has safety circuits to prevent faulty technique. A needle with a double

lumen was constructed, with the injecting and sampling sites 2 cm apart, enabling flow to be measured in a single vessel. Evaluation of this needle in a model system showed reproducibility and satisfactory agreement with simultaneous determination of flow by direct collection. The short transit time enables effective curves to be obtained using small doses of ^{125}I-Cholegrafin and because this substance is rapidly excreted, the radiation dose to the patient and background activity of the blood are markedly reduced. A satisfactory cardiac output curve can be obtained with 15 μC ^{125}I-Cholegrafin and this represents a radiation dose of 1 mrad which compares favorably with 100 to 500 mrad from a chest x-ray. (BBB)

22616 MULTIPLE PUNCH GRAFTS IN RADIATION ATROPHY OF THE SKIN: REPORT OF A CASE. Martz, Willard (Veterans Administration Hospital, Long Beach, Calif.). Arch. Dermatol., 94: 201-2(Aug. 1966).

Radiation atrophy following treatment of skin carcinoma of the face can cause considerable disfigurement and limitation of function, for which complete surgical excision and skin grafting are often recommended. A case is reported of a cosmetic and functional abnormality resulting from radiation atrophy following treatment of carcinoma of the lip. This condition, which would have otherwise required extensive plastic surgical repair, was improved by punch grafting, a simple procedure. Atrophy had occurred at the site of a squamous cell carcinoma treated by radiation 11 yr previously with 5500 R given in equally divided doses during a period of 14 days. Since the blood supply in areas of radiation atrophy may not be diminished, as has usually been assumed, whether the vascular supply to the atrophic area could support grafts was determined. A biopsy specimen was taken from the center of the lesion using a punch 4 mm in dia and a full-thickness graft punched out of the skin of the upper inner surface of the right arm was then placed in the cavity. After one month the 4-mm island of healthy skin was to be surrounded by a small collar of erythema extending from the margin of the graft into the atrophic skin. Thirteen more successful grafts were similarly made. (BBB)

22617 ATTEMPTS TO PROTECT THE PROCESS OF IMMUNOGENESIS IN IRRADIATED MICE BY MEANS OF CELL-FREE SPLEEN PREPARATIONS. Benes, S.; Mihaiesco-Nigrim, Maria; Turcanu, Al. G.; Cioranesco, Sanda (Centrul de Radiobiologie si Biologie Moleculara, Bucharest). Arch. Roum. Pathol. Exp. Microbiol., 23: 701-14(Sept. 1964). (In French).

Whole-body exposure to a single dose of 500 R of x radiation strongly inhibited the appearance of sheep red cell agglutinin in RAP strain mice inoculated 24 hr after irradiation. As compared with nonirradiated inoculated animals, the irradiated group displayed an increased induction period and significantly lower mean titers. The protecting action of cell-free mouse liver homogenate and extract, administered to irradiated animals in amounts of 0.5 and 1.43 spleen equivalents respectively, was expressed by a significant increase in mean titers, as compared with those in untreated irradiated animals and by a decreased total significant titer difference and mean total titer difference (also significant) between the irradiated and normal groups. In the group treated with 1.43 spleen equivalents of the extract the course of the titer-time curve was similar to that of the curve in the nonirradiated group and the peak mean titers were statistically similar. The action of irradiation on the group treated with 1.43 spleen equivalents of the extract was expressed only by a lower rate of antibody production. The shape of the titer curve in nonirradiated animals inoculated with antigen and with 1.43 spleen equivalents of the extract suggested that the preparation exerted an adjuvant action. Some criteria of immunological efficiency are discussed and comments are made on current hypotheses concerning protection and therapy by tissue preparations in radiation disease. (BBB)

22618 ROLE OF THE THYMUS IN TOLERANCE. III. TOLERANCE TO BOVINE GAMMA GLOBULIN AFTER DIRECT INJECTION OF ANTIGEN INTO THE SHIELDED THYMUS OF IRRADIATED RATS. Staples, Parker J.; Gery, Igal; Waksman, Byron H. (Yale Univ., New Haven). J. Exp. Med., 124: 127-39 (Aug. 1, 1966).

Attempts were made to produce tolerance to bovine γ-globulin by injecting this antigen directly into the thymus of adult rats, deprived of a competent pool of peripheral small lymphocytes by irradiation. The treatment groups included normal rats, rats exposed to 800 R whole-body x radiation with lead shielding of the thymus or the spleen, and similar rats injected immediately after irradiation with either bovine γ-globulin (BγG) or chicken ovalbumin (Ea) directly into the thymus or spleen or intraperitoneally. Rats subjected to irradiation, with simultaneous shielding of the thymus or spleen, recovered at 3 weeks the ability to develop delayed sensitization and to form hemagglutinating and precipitating antibody following foot-pad injection of BγG in complete adjuvant. Injection of BγG into the shielded thymus immediately after irradiation, in amounts between 20 μg and 40 mg, inhibited this response to later challenge partially or completely. A comparable effect on immune responses to BγG was not seen after injection of heterologous antigen (Ea) intrathymically, BγG intraperitoneally, or BγG into the shielded spleen. However, high doses (20 or 40 mg) of antigen given by the latter routes resulted in some diminution of later response. (BBB)

22619 THERAPY OF HYPERTHYROIDISM. Danowski, T. S. (Univ. of Pittsburgh). Bull. Pol. Med. Sci. Hist., 8: 4-7(Jan. 1965).

The effectiveness and possible complications, e.g. hypothyroidism, of the radioiodine treatment of thyrotoxicosis are reviewed and compared with results obtained by surgical ablation of the gland. It is generally agreed that ^{131}I therapy should be reserved for patients in or beyond the fifth decade of life to reduce the possibility of neoplasia and for those who at any age are poor surgical risks. The total dosage of ^{131}I which proves effective in most patients lies between 2.5 and 10 mCi, although as much as 70 mCi or more may ultimately be necessary. This may be given in 1 to 4 or more sessions spaced two or more months apart. Most patients, i.e., 60 to 70%, became euthyroid or hypothyroid after one treatment. In determining the dosage for a particular patient some clinics attempt to estimate the size of the gland, but this usually involves gross errors. Since immediate remissions are not obtained, thyrotoxicosis in patients receiving ^{131}I may have to be temporarily controlled by drugs. Ultimately, however, prolonged remission can be achieved in 90% or more of the patients. This is more readily accomplished in diffuse toxic goiters than in nodular goiters. Post-treatment myxedema must be prevented by thyroid therapy. Iodine-131 therapy also causes concern about possible thyroid crisis and requires follow-up observations. However, operative mortality, recurrent laryngeal nerve palsy, and probably hypoparathyroidism are entirely avoided. The ^{131}I cannot be administered in thyrotoxicosis present beyond the tenth week of pregnancy because of the injury to the fetal thyroid. (BBB)

22620 THE ROLE OF RADIOACTIVE PHOSPHORUS IN THE INVESTIGATION OF CERVICAL LESIONS. Thoms, George (Peter MacCallum Clinic, Melbourne). Austral. New Zeal. J. Obstet. Gynaecol., 6: 40-1(Feb. 1966).

A new radioisotope technic and a newly designed scintillation counter are described which employ radiophosphorus to detect lesions in the uterine cervix. Three mC of ^{32}P is administered intravenously 24 hr before the cervix is scanned. This lessens the chance of a false low count rate due to failure of absorption of an oral dose. Two cervical counters were developed, 1 for the ectocervix with a 7-mm window and 1 for the endocervical canal with a 5-mm window. The aim is to localize areas of excessive cellular radioactivity in cervices associated with a positive smear. The test takes 15 min as an out-patient procedure and causes minimum discomfort to the patient. To date, 55 cervical lesions have been investigated in this manner, and it has been shown that malignant lesions concentrate ^{32}P more than twice as much as normal tissue does. The scan 24 hr after intravenous administration of the isotope enabled patients to be classified into broad groups, according to the degree of cellular activity. In the first group the count rate per 30 sec was greater than 100 and the ratio of abnormal to normal tissue greater than 2. The diagnosis of lesions in this group was as follows: squamous cell carcinoma, 20; adenocarcinoma, 1; and squamous cell carcinoma and carcinoma in situ, 1. (BBB)

22621 K EXIT FROM THE SPLEEN AND KIDNEYS OF IRRADIATED MICE DURING THE EARLY POSTIRRADIATION PERIOD. Burdin, K. S.; Parkhomenko, I. M. Nauch. Dokl. Vyssh. Shkoly, Biol. Nauk., No. 1, 94-7(1966). (In Russian).

The effect of γ-radiation on loss of K^+ from the kidneys and spleen of mice under varying experimental conditions was investigated. Experimental conditions were: in vitro irradiation of kidneys and spleen with 50 to 60 kR γ radiation; whole-body γ-irradiation with 0.8, 1.6, and 10 kR; injection of acrylamide or vinylpyrrolidinone 45 min before irradiation; and administration of AET or pyridine 10 min before irradiation. Potassium ion exit from the kidneys and spleen was determined by measuring the rate of K^+ accumulation that occurred when the organs were placed in an isotonic solution of sucrose. With organs from the irradiated as well as the nonirradiated animals, the K^+ level in the sucrose solution reached constant values during 80 to 120 min. In comparison to controls the rate of K^+ accumulation from the in vitro irradiated organs increased. Potassium exit from the organs of whole-body irradiated mice occurred more rapidly than that in nonirradiated animals. The administration of 5% solutions of acrylamide and vinylpyrrolidinone inhibited K^+ exit from the kidneys and spleen; AET and

pyridine did not inhibit K^+ exit. When pyridine was administered to non-irradiated animals, K^+ exit from the kidneys and spleen was inhibited. (TSS)

22622 COMPARATIVE STUDIES ON THE PROTECTIVE ACTION OF THE S,2-AMINOETHYL-ISOTHIURONIUM Br. HBr (AET) AND PHENYLEPHRINE ON THE ACUTE INTESTINAL DEATH OF MICE. Nakatsuka, Haruo; Fukui, Yoshinori (Osaka City Univ.). Nippon Igaku Hoshasen Gakkai Zasshi, 26: 425-31 (Aug. 1966). (In Japanese).

Comparative studies on the protective action of AET and phenylephrine against the effects of partial body radiation were carried out with mice. AET was more effective than phenylephrine in prevention of acute intestinal necrosis in abdomen-irradiated mice. However, AET and phenylephrine were equally effective in protection against radiation effects in abdomen-shielded mice. Results suggested that AET and phenylephrine acted via different pathways; it was suggested that phenylephrine produced a protective effect by means of tissue anoxia caused by vasoconstriction that was more active in the bone marrow and spleen than in the small intestine. (TSS)

22623 BIOLOGICAL POTECTION MECHANISMS OF THE RADIOPROTECTORS ON THE MAMMALIAN CELLS. VII. A PRELIMINARY EXAMINATION OF THE CELL CYCLE IN EHRLICH TUMOR CELLS BY MEANS OF ^{3}H-THYMIDINE AND 8-AZAGUANINE. Kawamura, Fumio; Kobayashi, Jindo (Tokushima Univ., Japan). Tokushima J. Exp. Med., 12: 101-6(Feb. 1966).

The effect of 8-azaguanine which causes mitotic inhibition in malignant cells was examined by the ^{3}H-thymidine labeling method. Ehrlich ascites carcinoma cells were injected intraperitoneally into mice and ^{3}H-thymidine and 8-azaguanine treatment was begun between the fifth and sixth day after inoculation. The cell cycle in Ehrlich ascites tumor cells consists of a pre-DNA synthetic period (G_1), DNA synthetic period (S), premitotic period (G_2), and mitotic period (M). The average S period was about 7 hr, and about 5.5 hr was required for the cells to go through G_2. The total generation time was 16 hr. On the 6th day after transplantation, when the tumor-bearing mice received a single injection of 8-azaguanine in a dose of 5 mg/25 g, within 4 hr after the treatment the mitotic index was unchanged and morphologically no changes were visible in tumor cells. In the next 4 hr the mitotic frequency decreased rapidly and mitotic index showed a minimum value of 6 hr after treatment. Increased mitotic frequency occurred 7 to 15 hr after administration of the drug and the index was normal by 16 to 24 hr. The generation time of about 17 hr consisted of G_2, 5.5; S, 7.5; and G_1 + M, 4 hr. (BBB)

22624 BRONCHOGENIC CARCINOMA: FURTHER EXPERIENCE WITH PREOPERATIVE IRRADIATION. Linberg, Eugene J.; Cowley, R. Adams; Bloedorn, Fernando; Wizenberg, Morris J. (Univ. of Maryland, Baltimore). Ann. Thorac. Surg., 1: 371-9(July 1965).

The use of preoperative radiotherapy in 192 cases is reported, complications of irradiation are cited, and recommendations are made for reducing these complications. Two months before surgery 4500 rads was delivered to the primary site and mediastinum through anterior and posterior ports over a 4-week period, followed by rotational therapy of another 1000 to 1500 rads during the next week. The most serious and most common complication was empyema, ordinarily associated with a bronchopleural fistula. There were 21 such occurrences, ending fatally in 16 instances. Most of these were in patients with incurable lesions, and although irradiation of the bronchus was a factor, the cancer was extensive in most of these patients and was also a factor in the patient's complication and eventual death. It is suggested that complications can be minimized by the following: shortening the waiting period for surgery to one month after irradiation, avoiding dissection in a fibrotic irradiated chest wall, planning the incision to avoid the heavily irradiated chest wall areas, meticulously closing the skin and muscle, performing a space-reduction procedure after lobectomy if there is any doubt about ability of remaining lung to expand, and decreasing the irradiation dose by about one-fourth. It is concluded that preoperative irradiation in bronchogenic carcinoma is feasible and that some inoperable tumors can be made operable. Mediastinal lymph node metastasis can be controlled in a significant number of patients. Patients originally inoperable who are made operable by irradiation have survival rates approaching those of patients thought initially operable. The complication rate was high but is diminishing and can be reduced even further. (BBB)

22625 INFLUENCE OF REGIONAL OXYGENATION ON OSTEORADIONECROSIS. Bond, W. R. Jr. (Brooke Army Medical Center, Fort Sam Houston, Tex.); Matthews, J. Lester; Finney, J. W. Oral Surg., Oral Med., Oral Pathol., 23: 99-113(Jan. 1967).

Experiments were conducted in monkeys to determine whether regional oxygenation effected by intra-arterial infusion of hydrogen peroxide prevents osteoradionecrosis. Clinical, radiographic, and microscopic osteoradionecrosis was consistently reproduced in the monkey mandible without complicating side-reactions. An effective technique for providing increased oxygen tension in monkey mandible by intra-arterial infusion of hydrogen peroxide is described. These procedures were performed in 6 Macaque rhesus. The 6 right mandibles were irradiated and infused, while the 6 left mandibles were used as irradiated-only controls. Histopathologic study indicated that the combination of irradiation, intraarterial hydrogen peroxide infusion, and trauma caused certain expected and unexpected changes in bone. The expected bone marrow suppression following irradiation was significantly reversed by regional oxygenation in all 6 infused mandibles, while the 6 control mandibles were unaltered. Hydrogen peroxide also stimulated osteogenesis and proliferation of young cancellous bone, subperiosteally, endosteally, and within the dental pulp. In addition, it seemed to block the expected development of endarteritis and periarteritis, resulting in arteriolar and capillary proliferation. Thus, many of the detrimental features of osteoradionecrosis were reversed under the conditions described. This technique may offer a treatment method for other therapeutic problems associated with avascularity, tissue necrosis, anoxia, or delayed wound healing. (BBB)

22626 ON THE SUBJECT OF THE LECTURE OF M.Z.M. BACQ, ENTITLED: "CHEMICAL PROTECTION AGAINST IONIZING RADIATIONS IN MAMMALS." Maisin, J. Bull. Acad. Roy. Med. Belg., 6: 293-300(1966). (In French).

New experimental data are presented which are in conflict with some previously expressed concepts (ibid., 6: 115-41(1966)), and which indicate that no one theory yet proposed can explain the action of radioprotective agents. The protective action of cysteamine against the radiomimetic agent Myleran was examined. Protection was maximal when cysteamine (69 mg/kg) was injected intraperitoneally 2 hr before Myleran (17 mg/kg). When injected at 1 hr before it was less effective, and equivalent in effect as when injected 8 hr previously. Maximal protection against x rays was noted when cysteamine was administered by the same route 10 to 45 min before x irradiation of rats. A correlation was noted between its toxicity and protective activity; that is, it was most effective against radiation when given in near-toxic doses. Also, when given orally it was less effective than when injected. These and various other data which are cited suggest that the protective effect of sulfhydryl compounds cannot be explained in terms of their scavenging effect on radicals produced by ionizing radiation. Rather, a mechanism based on biochemical shock is proposed to account for radioprotection afforded by cysteamine. (BBB)

22627 TRACERS FOR THE DETECTION OF BRAIN TUMORS: EVALUATION OF RADIOIODINATED HUMAN SERUM ALBUMIN AND RADIOIODINATED FATTY ACID. Tator, Charles H.; Evans, John R.; Ciszewski, Jerzy (Toronto General Hospital, Can.). Neurology, 16: 650-61(July 1966).

A comparison was made of the effectiveness and tissue distribution of radioisotopes used for brain scanning. Radioiodinated (^{125}I) human serum albumin (RIHSA) and radioiodinated (^{131}I) oleic acid complexed with albumin (RIFA) were injected intravenously into mice bearing a transplantable ependymoblastoma. RIFA was also evaluated as a tracer for the diagnosis of human brain tumor, and the metabolism of RIFA in the mouse tumor and brain was studied. Mouse tumor took up more RIFA than RIHSA for at least 1 hr after injection, while mouse brain took up less RIFA than RIHSA at all times after injection. The maximum tumor/brain ratio with RIFA was 20 and was reached 2 hr after injection. The tumor/brain ratio with RIHSA did not exceed that of RIFA until about 24 hr later but the ratio reached a maximum of 29 at 48 hr after injection. In 8 patients with brain tumors given RIFA by intravenous injection, tumors were detected by γ encephalography in 6. The optimum time for brain scanning was within 90 min of injection. When compared with RIHSA, RIFA offered the advantage that scanning could be carried out sooner after injection. However, with RIFA, the tumors were less clearly demarcated, and, in particular, tumors situated inferiorly in the cranium tended to be obscured by radioactivity in scalp muscles. (BBB)

22628 LEUKEMIC INFILTRATES IN THE IRIS: SUCCESSFUL TREATMENT OF SECONDARY GLAUCOMA WITH X-IRRADIATION. Fonken, H. A.; Ellis, Philip P. (Univ. of Colorado, Denver). Arch. Ophthalmol. (Chicago), 76: 32-6(July 1966).

The use of x radiation to destroy leukocyte infiltration of the eye in a case of leukemia, without injury to the eye, is described. Leukemic infiltration of the iris and trabecular structures with the development of secondary glaucoma occurred in this case of acute lymphogenous leukemia. Dramatic improvement of the ocular condition occurred with x-ray therapy. The effects of x

radiation were demonstrated by histopathologic study of the eyes performed after the patient's death two months later. Irradiation therapy was planned so as to avoid the possibility of x-ray-induced cataractogenesis. The total dose of 250 R given over a 5-day period was below the minimal amounts reported as being required for progressive cataract formation. (BBB)

22629 INFLUENCE OF TEMPERATURE, ANOXIA, AND CYSTEAMINE ON RADIOSENSITIVITY OF THYMOCYTES (IN VITRO). Tanaka, Yoshimasa (Kyoto Univ.). Nippon Igaku Hoshasen Gakkai Zasshi, 26: 49-54(Apr. 1966).

Effects of cysteamine, oxygen abundance, and temperature on the radiosensitivity of thymocytes were studied. Cysteamine under anoxic conditions gave much better protective effects than cysteamine in the presence of air. In an oxygen saturated suspension, a significant decrease in sensitivity was noted at subfreezing temperatures; discontinuous changes at freezing points were found. In an oxygen depleted suspension cysteamine (in air) or under anoxic conditions showed no remarkable changes at the freezing point. Cysteamine under anoxic conditions provided significantly better protection than either anoxia or cysteamine alone. Oxygen saturated suspensions showed little change in sensitivity at temperature above freezing (4°C). Lowering of the irradiation temperature to −20°C increased radiosensitivity to that of liquid suspensions. (TSS)

22630 EFFECT OF DIMETHYL SULFOXIDE ON RADIATION DERMATITIS. Irie, Goro; Sugawara, Tadashi (Hokkaido Univ., Japan). Nippon Igaku Hoshasen Gakkai Zasshi, 26: 210-14(May 1966). (In Japanese).

Dimethyl sulfoxide (DMSO), locally applied to the skin during x radiotherapy for carcinoma of the cervix, exerted a protective effect on the development of radiodermatitis to such a degree that only exfoliation and pigmentation occurred. The duration of inflammation was also shortened. Results suggested that DMSO had a prophylactic effect on x radioinduced dermatitis. Changes in the skin of two patients undergoing x radiotherapy for breast cancer were effectively maintained to states of exfoliation when local applications of DMSO were made. Lesions of radiodermatitis accompanied by vesicular erosion were effectively dried and epitheliogenic function was promoted by DMSO. Itching caused by radiodermatitis was less in DMSO treated groups than in control groups. Only one of 20 patients exhibited an allergic response to DMSO. (NSA of Japan)

22631 SOURCES OF MECHANICAL ERRORS IN ^{60}Co CONFORMATION RADIOTHERAPY. Kitabatake, Takashi; Ueda, Toshio (Aichi Cancer Center, Japan). Nippon Igaku Hoshasen Gakkai Zasshi, 26: 899-902(Oct. 1966). (In Japanese).

Mechanical errors in telecobalt conformation radiotherapy are known to be produced by such factors as a shift of the rotation center, irregularity of rotation speed, cam making process, shift of the light pointers, and uncertainty of skin markings. The former three errors were considered to be essential in this study. Results showed that the rotation center shifted within a circle of a 2.2 mm diameter; no irregularity was detected in rotation speed except for the initial 5 seconds when speed was increased about 20%; an error of 5% was recorded for the cam making process, however this was considered to be practically negligible. (NSA of Japan)

22632 ROLE OF FATTY ACIDS ON RECOVERY OF MICE EXPOSED TO TOTAL BODY IRRADIATION. Tanaka, Yoshimasa; Hashimoto, Takaji (Kyoto Univ.). Nippon Igaku Hoshasen Gakkai Zasshi, 25: 998-1006(Nov. 1965).

The roles played by polyunsaturated fatty acids, particularly linoleic and oleic acids, in radiation protection and recovery were investigated in mice. Animals were divided into eight groups and supplied diets supplemented with 1, 5, 10, and 20% safflower oil; 1% methyl linoleate; 5% olive oil; 5% hydrogenated bean oil; or a diet entirely free of fat. After 25 days of feeding, mice were subjected to single or fractionated whole-body γ radiation doses. Average survival time, fluctuations in body weight, percentage survival, and iron metabolism were determined. In both fractionated and single whole-body irradiated mice, average survival time and percentage survival were considerably lower in rats fed a fat-free diet than in rats fed fat-supplemented diets; 20% safflower oil had less effect on percentage survival than did 10% safflower oil. Diets supplemented with 1% safflower oil had more effect than did the fat-free diet, but was not much different from the 10% safflower oil diet. Supplementation of the diet with 5% hydrogenated bean oil and forced feeding of polyunsaturated fatty acids with a stomach tube was somewhat detrimental. Body weight loss in mice fed diets supplemented with polyunsaturated fats was less than in rats fed a fat-free diet. Iron-59 uptake was considerably depressed in mice fed the fat-free diet as compared to mice fed 10% safflower oil diet. It was concluded that essential fatty acids may play a role in the restoration of radiation-injured bone marrow. (NSA of Japan)

22633 ROLE OF OXYGEN IN THE PHENOMENA OF CHEMICAL PROTECTION AGAINST IONIZING RADIATION. Bacq, Z. M. (Univ., Liege); Alexander, P. pp 509-36 of Symposium on Oxygen in the Animal Organism. Dickens, F.; Neil, E. (eds.). London, Pergamon Press, 1964.

The presence of molecular oxygen (at its normal pressure in air) increases by a factor of 2 to 3 most of the effects of x or γ irradiation on living and nonliving systems. Arguments in favor of anoxia (or decreased O_2 pressure) as the main mechanism of action of some radioprotectors are considered. Some of the most powerful radioprotectors are thiol substances such as cysteine, cysteamine (mercaptoethylamine or MEA), reduced glutathione, and mercaptoethylguanidine (MEG) which, in aqueous solution at neutral or slightly alkaline pH oxidize readily to S−S compounds and thus consume the O_2 which may be present in solution. There are many facts in favor of anoxia as the main (though not the exclusive) mechanism for the radioprotective action in mammals by acetylcholine, histamine, catecholamines, and chloropromazine. For tryptamine and 5-hydroxytryptamine, arguments in favor of anoxia are numerous, but mechanisms not involving oxygen cannot be excluded. As far as the most powerful radioprotectors, the thiol agents (cysteamine, cysteine, AET, or MEG) are concerned, anoxia is not the main mechanism responsible for radioprotection either for mammals, cells in vitro, or viruses. Radiochemical investigations, first with model systems and more recently with cell nuclei and whole cells, indicate that these SH compounds protect by a repair mechanism in which O_2 is involved. In vegetative systems a repair reaction by added SH substances would be essentially instantaneous and at its most effective in the presence of oxygen. (BBB)

22634 EFFECT OF DICAPTOL IN ACUTE RADIATION SICKNESS. Manoilov, S. E.; Grannikova, A. V. (Central Scientific-Research Inst. of Roentgen-Radiology, Leningrad. Leningrad Chemical and Pharmaceutical Inst.). Radiobiologiya, 6: 630(1966). (In Russian).

The effect of protective agents in acute radiation sickness was investigated using dicaptol, which was chosen for its ability to form complex compounds with metal enzymes and to inhibit their function. Thirty-nine hybrid white mice were injected intramuscularly twice in four hr with 0.2 ml dicaptol, and, immediately following the last injection, were irradiated with 800 R on a RUM-3 device (18 ma, 180 kv, 0.5 mm Cu and 1 mm Al filters, 50 R/min). The effect of the preparation was determined on the basis of viability, body weight, and leukocyte count. Results showed that 67.8% of the experimental animals survived compared to 5% for the controls (the majority of deaths occurring from the 5th−12th days after irradiation). The test animals lost both groups, but then returned to normal in the test group. Dicaptol apparently forms a complex compound with the metal enzymes which participate in tissue respiration, inhibiting their active role. Penetrating radiation cannot destroy this compound, so the metal enzymes remain unharmed. Dicaptol later separates from the metal enzymes, freeing them to participate in tissue respiration. Dicaptol, cyanide, and irradiation, all of which increase the sensitivity of animals to hypoxia, inhibit, and therefore protect, the activity of metal enzymes (cytochromes and others) in tissue respiration. (auth)

22635 APPLICATION OF RADIOMIMETIC MODEL FOR INVESTIGATION OF PROTECTIVE PROPERTIES OF CHEMICAL COMPOUNDS. Kakushkina, M. L.; Kudryashov, Yu. B. (Moscow State Univ.). Radiobiologiya, 6: 587-90(1966). (In Russian).

The efficiency of radioprotectors and other inhibitors belonging to different chemical classes was comparatively evaluated using the radiomimetic model. The protective capacity of a compound was measured on the basis of the rate of destruction of erythrocytes under the influence of the radiomimetic oleic acid in the presence and absence of the compound to be studied. The results obtained are graphed. Cysteamine was effective not only before but after the addition of oleic acid. Phospholipides did not appear to be radioprotective substances, and the radioprotective efficiency of polysaccharides during oleic acid hemolysis can be one of the secondary properties of the effect of this class of compounds which probably stimulates the reticulo-endothelial system. (J.S.R.)

22636 INFLUENCE OF SOME RADIOPROTECTORS ON RESPIRATION OF MITOCHONDRIA OF HEALTHY AND IRRADIATED TISSUES. Bicheikina, N. I.; Romantsev, E. F. Radiobiologiya, 6: 598-600(1966). (In Russian).

The intraabdominal injection of β-mercaptopropylamine (MPA), sodium nitrate, and paraaminopropiophenone (PAP) into rats in quantities sufficient to cause a radioprotective effect does not change the respiration of mitochondria isolated from the brain and liver of healthy and irradiated animals. The respiration of the mitochondria of the brain of healthy and irradiated animals was depressed to the same degree in vitro tests with different

concentration of MPA. The respirations of the mitochondria of the liver were depressed only with maximum concentrations of MPA. After irradiation the depression of the respiration of the liver mitochondria was very sharp and was recorded at small concentrations of aminothiol. β-mercaptoethylamine (MEA) depressed the respiration of brain mitochondria and showed no effects on the respiration of liver mitochondria of healthy animals in in vitro tests. The changes in the respiration of mitochondria appearing after the addition of different quantities of protectors to the in vitro tests were not connected with the swelling of the mitochondria and changes in the optical density. (tr-auth)

22637 BICILLIN-1 AND BICILLIN-3 IN THE TREATMENT OF EXPERIMENTAL STAPHYLODERMIA OF IRRADIATED RABBITS. Solomin, N. L. Antibiotiki, 11: 1031-6(Nov. 1966). (In Russian).

One hundred and eight rabbits were used in the experiment. The first group of the rabbits was irradiated with roentgen rays in a dose of 700 R (therapeutic apparatus RUM-3). The second group of the rabbits was inoculated intracutaneously with staphylococcal cultures in amounts of 0.5 or 1.0 millirads of microbes. The rabbits of the third group were irradiated with roetgen rays and inoculated with staphylococcal cultures. The rabbits of the fourth group were irradiated with roentgen rays, inoculated with staphylococcal cultures and treated with bicillin-1 and bicillin-3. The studies showed that bicillin-1 and bicillin-3 did not change the picture of radiation sickness, but only increased reparative processes in the host organism and the inflammation foci, alleviated the disease symptoms markedly, and decreased the number of lethal cases. Bicillin-1 and bicillin-3 may be recommended along with other drugs for the prophylaxis and treatment of acute radiation sickness and its complications associated with pyogenic infection. (auth)

22638 PROBLEM OF RADIOPROTECTIVE PROPERTIES OF ANTIOXIDANTS. Strelkov, R. B.; Semenov, L. F. (Inst. of Experimental Pathology and Therapy, Sukhumi, USSR). Radiobiologiya, 6: 578-9(1966). (In Russian).

Sodium gallate, propyl gallate, and ionol show no protective effect on injection in white mice before irradiation. Sodium gallate, propyl gallate and ionol show therapeutic properties on injection in white mice after irradiation. Antioxidants recommended in the literature as protective agents for clinical utilization need review. (tr-auth)

22639 PROTEIN INFLUENCE ON DNA RADIOSENSITIVITY. Usakovskaya, T. S.; Tongur, A. M.; Tseitlin, P. I.; Pasynskii, A. G. (Inst. of Experimental Biology, Moscow. Inst. of Biochemistry, Moscow). Radiobiologiya, 6: 491-4(1966). (In Russian).

Data obtained from various methods (detection of single ruptures of the phophorus-ether bond, detection of latent periods of damage during ferment degradation, and electron-microscopic studies) showed that the protein protected the DNA from damage during irradiation of the nucleoprotide complexes. (tr-auth)

22640 A STUDY ON PRODUCTION BY ACTINOMYCETES OF BIOLOGICALLY ACTIVE SUBSTANCES WITH A PROTECTIVE EFFECT IN CASES OF RADIOMIMETIC DAMAGES. Klitsunova, N. V. (Scientific-Research Inst. for Research of New Antibiotics, Moscow). Antibiotiki, 12: 22-6(Jan. 1967). (In Russian).

As a model for searching and studying radioprotective substances a culture of Escherichia coli treated with radiomimetic substances, i.e., novembichinon and bruneomycin, an antitumor antibiotic was used. Such radioprotective substances, as AET, cysteamine, cystophos and arginine had a pronounced protective effect with respect to this model. Two hundred and thirty actinomycetes from various taxonomic groups were tested; 5 of them produced biologically active substances protecting E. coli K-13 from radiomimetic damages. (auth)

22641 THE TREATMENT OF ADVANCED CANCER OF THE PROSTATE BY INTRAHYPOPHYSIS IMPLANTATION OF ^{90}Y. Sibilly, A.; Weill, A.; Suhler, A.; Rieffel, R. (Travail de la Clinique Chirurgicale A, Strasbourg). J. Radiol., Electrol. Med. Nucl., 47: 647-52(Nov. 1966). (In French).

Sixteen cases of advanced metastatic cancer of the prostate were treated by intrahypophysic implantation of ^{90}Y. Isotopic hypophysiolysis was almost equivalent to a true hypophysectomy, and the technique used for the implantation is simple and sure. Although there was a 100% mortality in the cases studied, the cancers were in an advanced state and the isotope implantation caused a prolongation and analgesia. (tr-auth)

22642 STUDIES ON THE RADIOPROTECTIVE EFFECT OF GERANYL-HYDROQUINONE. Rudali, G. (Institut du Radium, Paris). Compt. Rend. Soc. Biol., 160: 1356-9(1966). (In French).

The administration of geranyl-hydroquinone in daily doses of 5 mg did not modify the mortality of male mice x irradiated with 1,100 or 700 R. The first dose of geranyl-hydroquinone was administered within fifteen minutes following irradiation. The product did accelerate the restoration of the number of white blood cells circulating in mice receiving 400 or 350 R. (tr-auth)

22643 IVth NORDIC MEETING ON CLINICAL PHYSICS, PROCEEDINGS, HANKO, FINLAND, SEPTEMBER 15-18, 1966. Rytila, A.; Spring, E. (eds.). Helsinki, University Central Hospital, [1966]. 138p. (In Swedish, Danish, and English). (CONF-660942).

Separate abstracts were prepared on nine papers that discuss radiodiagnosis, radiotherapy, and dosimeters. Twenty-eight additional papers discuss other aspects of applications of physics in medicine. (C.H.)

For abstracts of individual papers see: 21881, 22174–22179, 22644, and 22645.

22644 FAST NEUTRON THERAPY AS COMPARED WITH HIGH PRESSURE OXYGEN THERAPY: CURRENT VIEWS. Fowler, J. B. (Hammersmith Hospital, London). pp 19-32 of IVth Nordic Meeting on Clinical Physics, Proceedings. Rytila, A.; Spring, E. (eds.). Helsinki, University Central Hospital, 1966.

Results are summarized from experiments on mice, rats, and swine on the effects of single or fractionated doses of high-energy x radiation or fast neutrons on the growth of anoxic or oxygenated tumors. The use of high pressure oxygen combined with fractionated radiotherapy for the treatment of neoplasms of man is discussed. It is pointed out that high pressure oxygen tanks have been installed in several radiotherapy departments in the United Kingdom but definitive results of therapeutic effects are not yet available. (C.H.)

22645 THOUGHTS OF n, p, α, AND π. Larsson, Boerje (Uppsala Univ.). pp 33-6 of IVth Nordic Meeting on Clinical Physics, Proceedings. Rytila, A.; Spring, E. (eds.). Helsinki, University Central Hospital, 1966.

The possibilities of using chemicals to increase the therapeutic potentialities of radiations used for cancer therapy are discussed. Emphasis is placed on the use of neutrons, protons, α particles, and negative π mesons for radiotherapy. (C.H.)

22646 QUANTITATIVE EVALUATION OF SPLEEN FUNCTION USING ^{51}Cr-LABELED, HEAT-ALTERED ERYTHROCYTES. Fischer, Joseph; Wolf, Rudolf (Univ., Mainz). 24p. (CONF-660642-5). DTIE. Gmelin, AED-CONF-66-237-10.

From Society of Nuclear Medicine, 13th Annual Meeting, Philadelphia.

A short-time test with radioactive-(^{51}Cr or ^{99m}Tc) labeled, heated erythrocytes was found to be an extraordinarily sensitive means for investigating the integrity of the reticular network of the red pulp of the spleen. Disturbances caused either by obstruction with erythrocytes, decay products of proteins, or by alteration processes were easily and rapidly indicated. The method was also considered to be suitable for control of therapy effects. By means of a long-time test (using ^{51}Cr-tagged spherocytes) it was possible to examine the breakdown function of the spleen and the phagocytic function of the entire reticulo endothelial system. In connection with the spleen scan, both tests aided in the differential diagnosis of various diseases. (B.H.S.)

22647 FALSE-POSITIVE HEPATIC SCAN. Johnson, Philip M.; Sweeney, William A. (Presbyterian Hospital, New York). 16p. (CONF-660642-1). ORAU. Gmelin, AED-CONF-66-237-2.

From Society of Nuclear Medicine, 13th Annual Meeting, Philadelphia.

Scintillation scans of the liver falsely suggestive of intrahepatic mass lesions were encountered in 7 of 24 cirrhotic patients undergoing porta-systemic anastomosis for portal hypertension. The false-positive hepatic scan results from regionally reduced or absent radioactivity. Several mechanisms that apparently contribute to the false-positive scan are discussed. Clues to its detection are found in the presence of significantly increased extrahepatic radioactivity. Colloidal radiopharmaceuticals are therefore recommended for hepatic scanning. (auth)

Radiation Effects on Animals

Refer also to abstracts 21938, 22233, 22239, 22255, 22258, 22269, 22271, 22301, 22319, 22415, 22486, 22487, 22494, 22511, 22517, 22607, 22618, and 22789.

22648 (ACRH-26, pp 16-22) REGULATION OF NUMBERS OF PRIMITIVE HEMOPOIETIC CELLS. Gurney, C. W.; Fried, W. (Argonne Cancer Research Hospital, Chicago, Ill.).

Results are reported from studies on the differentiation of primitive hemopoietic cells of mice into the erythroid line. Studies on x irradiated mice given a single dose of erythropoietin led to the conclusion that both erythropoietin-sensitive cells and spleen colony-forming units or cells constitute compartments of primitive hemopoietic cells whose numbers are regulated. (C.H.)

22649 (ANL-7300(Issue 2)) LABORATORY ANIMAL SCIENCE. A Review of the Literature for April-June 1966. Abstracts 124-468. Flynn, Robert J. (Argonne National Lab., Ill.). Nov. 1966. Contract W-31-109-eng-38. 134p. Dep. mn. CFSTI $3.00 cy, $0.65 mn.

A list of 344 references to journal articles on laboratory animals is given. A short abstract of each article is included. The following aspects of animal science are considered: care, management, facilities, equipment; nutrition; environment; genetics, special strains, strain effects; species and strain characteristics; reproduction; specific pathogen-free and germfree technology; infectious diseases; noninfectious diseases; zoonoses; and zootechniques. Author and species indexes are included. (H.L.W.)

22650 (CMN-Pub-3/66) PRIMEIRO CURSO LIVRE DE FISIOPATOLOGIA DAS RADIACOES (A ACAO DAS RADIACOES IONIZANTES SOBRE OS SERES VIVOS, COM ESPECIAL REFERENCIA AO HOMEM E AOS MAMIFEROS). (First Course on Radiation Physiopathology (Studies of Effects of Ionizing Radiation on Life Organisms With Special Reference to Men and Mammals)). Ludwig, Frederic (Sao Paulo Univ. (Brazil). Centre de Medicina Nuclear). 1966. 22p. (In Portuguese). Dep. mn.

The first course in radiation physiopathology is outlined. Course sections include fundamental concepts of damage induced by radiation, the effects of the atomic bomb, hematology of radiation leukemia resulting from radiation, delayed effects in radiation sickness, and aging as an experimental problem. Bibliographies are given for each section. (J.S.R.)

22651 (EUR-3261.i) RICERCA SULLA DIFFERENZIAZIONE DI CELLULE IMMUNOLOGICAMENTE COMPETENTI IN ANIMALI IRRADIATI. Relazione Finale, 1963-1965. (Study on the Differentiation of Immunologically-Competent Cells in Irradiated Animals. Final Report, 1963-1965). Doria, G. (Comitato Nazionale per l'Energia Nucleare, Casaccia (Italy). Centro di Studi Nucleari). Nov. 23, 1966. 26p. (In Italian). Dep. mn.

Researches have been carried out on the differentiation of immunologically-competent cells in rats irradiated and transplanted with hemopoietic tissue. In particular, a study has been made of the role of the irradiated thymus in adoptive immunity. (auth)

22652 (MIT-3045-30) AUTORADIOGRAPHIC INVESTIGATION OF BRAIN METABOLISM UNDER NORMAL, EXPERIMENTAL, AND PATHOLOGICAL CONDITIONS. Annual Progress Report, June 1966-June 1967. Altman, Joseph (Massachusetts Inst. of Tech., Cambridge. Dept. of Psychology). Contract AT (30-1)-3045. 22p. Dep. mn. CFSTI $3.00 cy, $0.65 mn.

The proliferation and migration of the precursors of microneurons continue in infant and adolescent rats in the cerebellar cortex, hippocampal dentate gyrus, and a few other brain structures investigated. In the precocial guinea pig neurogenesis is nearly completed at birth in the cerebellar cortex, but is quite pronounced and prolonged in the hippocampal dentate gyrus. Suggestive evidence is accumulating that the postnatally-formed microneurons may play a role in the organization and reorganization of central nervous connections on the basis of peripheral input from the environment. In an effort to test the modifiability of the structural organization of the brain during infancy, rats were handled early in their lives, a treatment that affects some of the physiological and behavioral characteristics of the animal in adulthood. Preliminary results indicate radical changes produced by this treatment in the growth of the brain and in the rate of cell proliferation. As a complementary approach to test the hypothesis that these microneurons are the plastic elements of the brain, an experiment was undertaken that was aimed at the extirpation destruction of the precursors of microneutrons with low-level x ray. Using repeated doses of 200 R in developing kittens, the external granular layer of the cerebellum, the primary source of its microneurons, was selectively destroyed. Results are described in which thymidine-^{3}H autoradiography was utilized to inquire into degenerative and regenerative changes after transection of the facial nerve in rats. In another study, testosterone-^{3}H was injected systemically into rats to study the target organs of this hormone in the brain. (auth)

22653 (N-66-31381) THE GENERAL AND COMPARATIVE BIOLOGY OF TERRESTRIAL ORGANISMS UNDER EXPERIMENTAL STRESS CONDITIONS. Semiannual Report. Siegel, S. M. (Union Carbide Research Inst., Tarrytown, N. Y.). May 1, 1966. Contract NASw-767. 78p. (NASA-CR-76409). CFSTI $3.00 cy, $0.65 mn.

To correct the statement that ultraviolet light on Mars would prevent existence of any earth-type life, various terrestrial organisms were tested under ultraviolet fluxes of 400,000,000 Erg-cm^{-2} or more. Animal species, vascular plants, and other forms of terrestrial life subject to experimental stress conditions are discussed, as well as the relationship between ultraviolet radiation and oxygen. The germination of Allium and the growth of a variety of organisms in ammonia-rich environments is described. Unlike NH_3, that supported the germination of about 75% of 30 varieties and allowed only 10% germination at most, 0.01 M Na or KOH at the same pH (12) permitted at least minimal germination in all varieties. Germination in the 50% to 80% range was fairly commonplace in the alkalies and green shoots. A review of preliminary experiments is presented for the microbiology of ultrasaline, acidic, and other extreme chemical environments. Lymphocytes are used to demonstrate that membrane-monitored stress responses lead to increases in white cell number in a discussion on the relation of permeability to environmental stress. (auth)

22654 (NYO-3359-3) SPECIALIZED RESPONSES TO IONIZING RADIATION. PARTS I AND II. Third Year Progress Report, January 1, 1966-January 1, 1967. Shaber, Gary S. (Jefferson Medical Coll., Philadelphia, Pa.). Contract AT(30-1)-3359. 27p. Dep. mn. CFSTI $3.00 cy, $0.65 mn.

Progress is reported on studies of fibrinogen deposition and taste thresholds in x-irradiated rats. External whole-body x irradiation produced an increase in whole-body fibrinogen turnover and blood turnover up to a dose of 600 R. At higher doses the whole-body fibrinogen turnover decreased much more rapidly than did the blood fibrinogen turnover. ϵ-Aminocaproic acid produced the same effect; however, at lower dosages, which seems to imply that the body normally maintains fibrinogen turnover equilibrium through the fibrinolysin system even at relatively high x-ray doses. However, the system breaks down at extremely high doses; and the body is unable to cope with the extravascular deposition of fibrinogen. Possible mechanisms for the reaction are discussed. The taste threshold for saccharin in x-irradiated (50 rad to tongue) rats was found to be 0.0010%. Daily variation in the taste threshold for saccharin was minimal. A change in taste threshold in two animals that received 50 rad of head irradiation persisted from 1 hr to 6 days postirradiation. Three papers published during the report period are listed. (H.G.D.)

22655 RELATIONSHIP BETWEEN MEDICAL IRRADIATION AND DEVELOPMENT OF MALIGNANT LYMPHOMA: A RETROSPECTIVE SURVEY. Kitabatake, Takashi (Aichi Cancer Center, Japan). Nippon Igaku Hoshasen Gakkai Zasshi, 26: 891-3(Oct. 1966). (In Japanese).

A history of prior medical irradiation was surveyed in 581 malignant lymphoma patients and 2324 controls in Japan during 1961 to 1965. Of 581 malignant lymphomas 32 or 5.51% had a history of prior fluoroscopic examination, and 7 or 1.21% had a history of radiation therapy for benign diseases. On the other hand, 120 (5.16%) of 2324 controls had a history of fluoroscopy and 12 (0.60%) had a history of radiotherapy. There is no statistically significant difference between the frequencies of prior medical irradiation in both groups. Radiation dose in the lymphoid tissues was estimated, which tended to be slightly larger in the malignant lymphoma group than in controls. However no evident relationship between prior medical irradiation and later development of malignant lymphoma was revealed. However, if more large samples would be surveyed, significant difference might be produced. (NSA of Japan)

22656 QUANTITATIVE CHANGES IN THE OVARIAN FOLLICLE AFTER CONTINUED INTRAUTERINE RADIATION OF THE FETUS WITH SMALL DOSES OF GAMMA RAYS. Vorisek, Premysl (Anstalt fuer Muetter- und Kinderfuersorge, Prague). Strahlentherapie, 132: 409-15(Mar. 1967). (In German).

Difficulties encountered during the quantitative evaluation of oocytes in the ovary of rats are reported. A quantitative evaluation of the results observed in the follicle system was done in rats which had received intrauterine ^{60}Co-γ-irradiation with a daily dose of 2.5 R from the 1st to the 20th day of pregnancy. The following conclusions were drawn: A significant decrease of the absolute number of follicles was found in the ovaries of 25, 60, and 120 day old irradiated rats. The differences are statistically significant. The differences in the number of follicles are directly proportional to the age. Compared with the number of follicles in the ovary of control animals of the same age, the values obtained for the irradiated animals were: 34% (25 day old animals), 54.8% (60 day old), and 66.7% (120 day old). (auth)

22657 PROBLEM OF TRANSFER OF THE RESISTANCE EFFECT APPEARING AFTER IRRADIATION. II. RADIORESISTANCE IN GOATS. Waldschmidt-Leitz, Ernst; Keller,

Lorenz; Kohl, Irmhild (Heiligenberg-Instituts, Ger.). Strahlentherapie, 132: 454-62(Mar. 1967). (In German).

Changes in the ratio of the protein components in the serum as well as in the concentration of several other blood components observed after x irradiation in goats were measured. It was found that the resistance effect observed after an irradiation can be transferred from irradiated to non-irradiated animals by blood transfusion. Chlor-trianisen (Tace) exhibited a radiation protective effects in goats. (auth)

22658 STUDIES ON THE MECHANISM OF ENZYME INDUCTION IN RATS AND MICE. VIII. THE EFFECTS OF X IRRADIATION ON THE L-ASCORBIC ACID EXCRETION AND ON ITS BARBITAL-INDUCED INCREASE IN RATS, AND ON L-ASCORBIC ACID CONCENTRATION OF THE LIVER AND ITS INCREASE IN MICE. Klinger, W.; Finck, W.; Leibe, H. (Friedrich-Schiller-Univ., Jena, Ger.). Acta Biol. Med. Ger., 16: 415-22(1966). (In German).

The effects of 500-, 600-, and 1500-R doses of x rays on ascorbic acid (AA) metabolism were examined in Wistar rats and Agnes Bluhm mice. A study was also made of the influence of irradiation of the ability of barbiturates to augment the renal elimination of the the vitamin. A single dose of 600 R increased AA excretion for 3 days in rats; thereafter it fell, returning to normal on the 7th day after irradiation. The barbital-induced (3 doses of 150 mg/kg of body weight) increase of AA excretion was unaffected. Doses of 1500 R did not produce a significant change of AA excretion within the 4 days before the animals died, the induction by barbital of increased AA excretion being slightly reduced. In mouse liver the AA concentration was not changed after irradiation with 500 and 1500 R. The induction of excretion by previous or subsequent barbital treatment was not affected. A considerable radioresistance is therefore evident in the barbital-augmented excretion of the vitamin. (BBB)

22659 IMMUNITY TO HAEMONCHUS CONTORTUS INFECTION: FAILURE OF X-IRRADIATED LARVAE TO IMMUNIZE YOUNG LAMBS. Urquhart, G. M.; Jarrett, W. F. H.; Jennings, F. W.; McIntyre, W. I. M.; Mulligan, W.; Sharp, N. C. C. (Univ. of Glasgow). Amer. J. Vet. Res., 27: 1641-3 (Nov. 1966).

Successful vaccination of sheep against H. contortus with x-irradiated infective larvae has been achieved. The degree of protection produced in 7- and 9-month-old sheep against a single challenge dose of 8000 and 50,000 larvae was high. Since the potential value of x-irradiated, infective larvae as a vaccine would be greatly enhanced by demonstrating its efficacy in young lambs, 3-month-old lambs were vaccinated with 1 or 2 doses of irradiated larvae, and their immunity was challenged 1 month later. All larvae were exposed to 40 KR at a dose-rate of 200 R/min from an x-ray machine. A dose of 10,000 x-irradiated larvae administered orally once or twice to Blackface lambs did not confer any protection against a challenge inoculation of 20,000 normal larvae after vaccination. However, an identical regimen of vaccination conferred a high degree of protection to sheep of the same breed aged 7 months or over. The reason for this disparity was not known. The numbers of H. contortus found in lambs given x-irradiated larvae were only markedly reduced as compared to those in corresponding controls. The sex ratios indicated a marked predominance of female parasites, all having no eggs or abnormal eggs in their eteri, as a result of irradiation. (BBB)

22660 IN VIVO CELL KINETICS OF A NORMAL HUMAN TISSUE. Wiernik, George (Churchill Hospital, Oxford). Brit. Med. J., 2: 385-7(Aug. 13, 1966).

The basic pattern of response to x-ray-induced damage of an organized tissue and the repair thereof as it occurs in the human jejunal mucosa are described. The damage was caused by a therapeutic dose of x irradiation which affected mainly the crypt epithelial cells; the dose was insufficient to produce observable effects in the mature epithelial cells on the villi, so that any changes could be considered to be secondary to damage of the crypt epithelial cells. Furthermore, it was thought that irradiation caused nonspecific damage to the crypt cells, which form the proliferative compartment of the epithelial cells lining the intestinal mucosa. Three 800 R doses of ^{60}Co γ irradiation were given, followed by a 1000 R dose. Damage from irradiation was followed by a gradual fall in the number of epithelial cells lining both the crypt and the villus. On about the third day there was evidence of abortive mitotic recovery. After the sixth day sustained mitotic recovery occurred, followed 24 hr later by a gradual repopulation of the crypt and a further 24 hr later by an increase in the villous epithelial-cell count. The initial number of cells in each compartment was reached on the 12th and the 15th day respectively, after which the number continued to increase to about 20% above the normal value before falling once more to normal numbers. (BBB)

22661 EFFECTS OF RADIOTHYROIDECTOMY AND VARIOUS REPLACEMENT LEVELS OF THYROXINE ON GROWTH, ORGAN AND GLAND WEIGHTS OF CORNISH CROSS CHICKENS. Hendrich, C. E.; Turner, C. W. (Univ. of Missouri, Columbia). Gen. Comp. Endocrinol., 7: 411-19(Dec. 1966). (COO-301-112).

A method is described whereby Cornish Cross chickens were rendered hypothyroid by ^{131}I thyroidectomy. Soon after hatching, chicks were injected with 750 μCi of ^{131}I before being offered feed or water. This amount of ^{131}I was equal to about 1.5 mCi of ^{131}I/100 g body wt. After the disappearance of the initial dose of ^{131}I, a tracer dose of ^{131}I was injected, and 48 hr later cpm values were recorded for the neck area and compared with counts taken from the abdominal area. Thyroidectomy was judged complete in birds with a lower thyroid area count than abdominal area count. This dose of 750 μCi ^{131}I per chick effected complete thyroidectomy in all birds. Replacement levels of from 0.25 to 3.00 μg/100 g body wt of L-thyroxine daily were administered for 8 months until autopsy. Effects on body weight, organs, and glands are described in male and female birds. It was concluded that there may be differences between males and females as to their sensitivity to varying levels of thyroxine replacement. It is suggested that in the male in particular, varying levels of thyroid hormone may play a more significant role in development and function of the reproductive system. (BBB)

22662 STUDIES ON ACQUIRED RESISTANCE TO SCHISTOSOMA MANSONI IN MICE EXPOSED TO X-IRRADIATED CERCARIAE OF ONE SEX. Perlowagora-Szumlewicz, Alina (Departamento Nacional de Endemias Rurals, Rio de Janeiro). Rev. Inst. Med. Trop. Sao Paulo, 8: 203-18(Sept.-Oct. 1966).

Effects of x radiation (2000 or 2500 R) on cercariae of Schistosoma mansoni destined to be males or females was investigated by determining the worm return from irradiated unisexual infections in the portal system of the mouse. Egg-laying capacity of the worms was studied by determining liver egg accumulation in mice exposed to irradiated cercariae of one sex and challenged with normal cercariae of the other sex. Also investigated was the effect of prior exposure of mice to irradiated cercariae of each sex on the course of a challenge infection with normal worms. Although the worm burden in all mice was low after exposure to irradiated unisexual cercariae, worms were present continuously. Yields of worms from irradiated female cercariae exceeded yields of worms from irradiated male cercariae. More males than females resulted from normal cercariae. Large numbers of eggs were recovered from mice exposed to irradiated cercariae of one sex and challenged with normal cercariae of the other sex, indicating that when the radiation dose was not lethal to worms it was also inadequate to sterilize them. While an infection with irradiated male cercariae did not alter the course of a challenge infection, exposure to female cercariae irradiated with 2000 R reduced liver egg accumulation, reduced worm burdens in the portal system, and delayed deaths after challenge with normal cercariae. It is cautioned that introduction into the host of irradiated cercariae may give rise to a superinfection in the presence of normal worms of either sex. (BBB)

22663 A COMPARATIVE STUDY OF THE MECHANISMS BY WHICH X-IRRADIATION AND GENETIC MUTATION CAUSE LOSS OF VIBRISSAE IN EMBRYO MICE. Jacobson, C. M. (Univ. of Sydney). J. Embryol. Exp. Morphol., 16: 369-79 (Oct. 1966).

Both x irradiation and certain genetic mutations were observed to produce loss of vibrissae in mice. Embryos were obtained from random-bred females which had been irradiated with 200 R 8 to 14 days after mating, i.e., during the known period between vibrissa site determination and hair follicle initiation. Embryos were collected at 24-hr intervals after irradiation, providing a series of specimens ranging in age from 9 days to birth (at 21 days), irradiated at different stages of vibrissa development. In other experiments embryos from 4 variant lines carrying the Tabby gene were collected at 24-hr intervals from 12 days to birth. In the third series, embryos from the same 4 variant lines were subjected to the same irradiation technique used on the random-bred embryos. Results are reported from a histological investigation of vibrissae during early stages of development. (BBB)

22664 ON THE INFLUENCE OF TOTAL-BODY X-IRRADIATION AND OF 2,4,6-TRIETHYLENEAMINO-s-TRIAZINE ON RAT LIVER. Tempel, T.; Roessner, W. (Univ., Munich). Arzneim.-Forsch., 16: 1626-30(Dec. 1966). (In German).

Nuclei, mitochondria, DNA, and deoxyribonuclease II (DNase II) of rat liver were studied after total-body x irradiation with 330 and 600 rad and intraperitoneal injections of 2, 4, 6-triethyleneamino-s-triazine (triethylenemelamine, TEM). The doses used were 0.75 and 1.5 mg/kg body weight. On per wet weight basis the content of nuclei and mitochondria decreased significantly within

8 hr after irradiation and TEM treatment, and was lowest within 3 days. Control values were reached between 2 and 3 weeks after treatment. DNase II activity increased (on per wet weight basis) during the first 3 days only after high doses of x rays and TEM. With lower doses the enzyme activity was higher than controls by about 15 to 30% between 5 to 7 days. At about the same time DNA concentrations were diminished by 10 to 15%. It is suggested that changes in content of nuclei and mitochondria are the result of a lesion of the liver that is almost latent in vivo. Increase of DNase II activity and decrease of DNA concentration at the same time may be signs of necrosis and cytolysis. (BBB)

22665 SPONTANEOUS RECOVERY IN THE THYMUS AFTER SUPRALETHAL WHOLE-BODY X IRRADIATION. Thomas, D. Brynmor (Univ. of Birmingham, Eng.); Congdon, C. C. J. Physiol. (London), 188: 28P-29P(1967).

The effects of a single whole-body dose of 950 R of x irradiation on the thymus gland were observed in mice examined at daily intervals after exposure. Within 24 hr the thymus weight decreased to values one-third those observed in untreated animals. Histological examination revealed disappearance of closely packed lymphocytes. No pronounced changes occurred in the succeeding 4 days, but surprisingly on the sixth day collections of deeply staining cells appeared, indicating restoration of the thymic lymphocyte population. This pattern of transformation continued and became progressively more pronounced until on the tenth day when organization appeared to have been completely restored. On the eleventh day, however, regeneration was reduced and on the thirteenth day the glands were atrophic and very small. None of the animals survived longer than 13 days. It is concluded that the atrophy of the mouse thymus gland which occurs after exposure to 950 R of whole-body x irradiation, a supralethal dose, is followed by a phase of spontaneous regeneration during which the weight of the gland increases. After the tenth day, however, when the general condition of the few survivors deteriorates rapidly, secondary atrophy supervenes. In animals protected from the lethal effects of whole-body x irradiation by the intravenous injection of lymphomyeloid cells from nonirradiated donors, it is possible that secondary atrophy does not interrupt regeneration of the host thymus, which may therefore contribute to recovery in a significant fashion. The host thymus appears to contribute to the restoration of immunological reactivity in such animals. (BBB)

22666 STUDIES ON THE HATCHING OF THE ROOT-KNOT NEMATODE, MELOIDOGYNE INCOGNITA CHITWOOD. II. RADIOSENSITIVITY OF EMBRYOS AND INFECTIVITY OF LARVAE EMERGING FROM IRRADIATED EGG MASSES. Ishibashi, Nobuyoshi; Taguchi, Shigetoshi (Central Agricultural Experiment Station, Konosu, Japan). Annot. Zool. Jap., 38: 12-19(Mar. 1965).

Egg masses were irradiated with 5- to 350 kR doses of ^{60}Co γ rays or 7- to 42-kR doses of x rays, and emergence and infectivity of the larvae were studied. The number of larvae emerging from egg masses decreased as the dose of γ radiation increased. On the other hand, emergence of larvae from yellow-brown egg masses covered with a hard gelatinous substance, and from white egg masses which had been immersed in 0.3M NaCl solution for 9 days, to suppress emergence of larvae, were accelerated by irradiation at about 150 kR. Acceleration of hatching was most conspicuous on the first day after irradiation. Total emergence over 7 days was less in irradiated egg masses than in the nonirradiated controls in both immersed and nonimmersed white egg masses. Larvae that emerged from irradiated egg masses were abnormal. Larvae emerging from white egg masses which had been irradiated with x rays at 35 kR or more could neither mature nor propagate after invading tomato and sweet potato roots. However, a few egg masses were observed on the roots which were inoculated with immersed and yellow-brown egg masses, irradiated at 35 and 42 kR, respectively. (BBB)

22667 EFFECTS OF IONIZING RADIATIONS ON BLOOD COAGULATION AND FIBRINOLYSIS. EXPERIMENTAL STUDY IN THE RAT. Bertrand, H. (Centre Transfusion-Reanimation de l'Armee "Jean-Julliard," Clamart, France). Hemostase, 6: 167-84(1966). (In French).

Changes in clotting factor levels were studied in Wistar rats irradiated (^{60}Co) with whole-body doses of 150 and 600 R. Blood samples were tested 4, 7, and 11 days after irradiation. Thrombocyte levels showed the most marked changes, falling to 25, 75, and 95% of normal at these respective test periods after 600 R irradiation. After 150 R, decreased levels (50% of normal) were noted by the 11th day. The prothrombin complex fell slightly after 600 R but not after 150 R. Prothrombin did not decrease after either dose. Proconvertin fell sharply after 600 R, but only slightly after 150 R. It was confirmed that thromboplastin formation is impaired after irradiation, its changes paralleling those of platelets. No increase of heparinoid substances in plasma could be found, but a heparin cofactor was found to be elevated in serum after irradiation. A marked drop in antiplasmins was noted. It is suggested that the effects of radiation on clotting factors and fibrinolysis are secondary, or indirect, in nature. (BBB)

22668 CYTOLOGICAL STUDIES OF ORGANOTYPIC CULTURES OF RAT DORSAL ROOT GANGLIA FOLLOWING X-IRRADIATION IN VITRO. I. CHANGES IN NEURONS AND SATELLITE CELLS. Masurovsky, Edmund B.; Bunge, Mary Bartlett; Bunge, Richard P. (Columbia Univ., New York). J. Cell Biol., 32: 467-96(Feb. 1967).

Cultured rat dorsal root ganglia were exposed to a single 40-kR dose of x rays and studied in the living and fixed states by light or electron microscopy at 1- to 14-day intervals thereafter. Within 4 days of irradiation, over 30% of the neurons displayed chromatolytic reactions as well as abnormal nucleolar changes and dissociation of ribosomes from endoplasmic reticulum cisternae. Some satellite cells underwent retraction or acute degeneration, leaving only basement membrane to cover the neuron in these areas. Eight days after irradiation, neurons also exhibited areas in which ribosomes were substantially reduced, regions of cytoplasmic sequestration, extensive vacuolization of granular endoplasmic reticulum and Golgi complex, and diversely altered mitochondria (including the presence of ribosome-like particles or association with abnormal glycogen and lipid deposits). Nucleolar components became altered or reoriented and formed abnormal projections and ringlike configurations. Sizeable areas of the neuronal soma were then denuded of satellite cells; underlying these areas, nerve processes were found abnormally invaginated into the neuronal cytoplasm. By the 14th day following irradiation, most neurons displayed marked degenerative changes including extensive regions of ribosome depletion, sequestration, vacuolization, autolysis, and, in some areas, swirls of filaments, myelin figures, and heterogeneous dense bodies. Thus irradiation produced profound cytopathological changes in nervous tissue isolated from the host and many of these changes resembled the effects of radiation on nervous tissue in vivo. (BBB)

22669 SCREENING FOR DRUG TOXICITY BY WAVE LENGTHS GREATER THAN 3100 A. Maibach, Howard I.; Sams, W. Mitchell Jr.; Epstein, John H. (Univ. of California, San Francisco). Arch. Dermatol., 95: 12-15(Jan. 1967).

Ultraviolet-induced phototoxicity was studied in normal subjects and demethylchlortetracycline (Declomycin) phototoxicity was used as an experimental model for developing a reliable method for determining the phototoxic potential of ingested agents activated by wavelengths greater than 3100 Å. Healthy adult male volunteers receiving 150 mg of the drug 4 times daily were exposed to various forms of light, including natural sunlight. All efforts to demonstrate phototoxicity of this standard agent failed until the erythema-producing rays of natural sunlight were excluded with plastic film (Mylar). When the erythema-producing rays of natural sunlight are removed with the plastic film and the subjects exposed to 2 to 4 hr of natural sunlight, obvious phototoxicity occurred. Drug-treated subjects demonstrated frank erythema, whereas control subjects had either pigment darkening (Meirowsky phenomena), or no response. Attempts to reproduce this result with artificial light sources failed. This model is proposed as a screening method to ascertain the phototoxicity of compounds absorbing light rays longer than 3100 Å. (BBB)

22670 REDUCED GROWTH RATES OF HAIR IN MICE FOLLOWING RADIATION. Malkinson, Frederick D.; Griem, Melvin L. (Argonne Cancer Research Hospital, Chicago). Arch. Dermatol., 94: 491-8(Oct. 1966).

Effects of single, acute doses of radiation on different types of mouse hair were studied to assess the usefulness of the hair matrix for microscopic studies of the kinetics of cell depletion and renewal following various forms of tissue injury. Anagen mouse hairs treated with single doses of x rays ranging from 200 to 800 rads showed postirradiation growth impairment as determined by overall hair length measurements. Reductions in hair lengths were dose-dependent and ranged from 8.3 to 13.4%. When telogen mouse hairs were exposed to single doses of 500 to 1500 rads and immediately plucked, the succeeding anagen hairs showed dose-dependent reductions in hair length of 5.1 to 12.7%. Photomicrographs of irradiated anagen hair enlarged 600 to 700 times revealed that about two thirds of the damaged hair segment underwent progressive or sustained narrowing, with an abrupt widening to normal dia in the remaining portion. Apparently, then, complete population recovery of residual hair matrix cells occurred abruptly within a period of 24 to 48 hr. The responses of the hair to radiation suggest the usefulness of the matrix cell population for further study of the kinetics of cell depletion and renewal and the mechanism which control release of cells from proliferative into maturing compartments. (BBB)

22671 CANCER OF THE RENAL PELVIS FOLLOWING RETROGRADE PYELOGRAPHY WITH THOROTRAST. Hubmann, Rolf (Univ., Homburg-Saar, Ger.). Urologe, 3: 227-37 (July 1964). (In German).

A review of thorotrast injury cites four criteria that have been advanced as preconditions for development of sarcomas by radiation from ThO_2. These are close contact between the ThO_2 crystals and the tumor cells, the lack of other cancerogenic factors, a definite latency period between incorporation of the ThO_2 and appearance of the tumor, and the detection of metastases of the primary tumor in remotely located organs as indications of its malignancy. The authors present studies of 4 cases of thorotrastoses of the kidney reported 18 to 30 yr after retrograde pyelography, and ThO_2 crystals were densely deposited in phagocytes whose nuclei were partially destroyed. Crystals were also observed in fibrocytes of collagenous connective tissue. The degree of changes observed were proportional to the concentrations of crystals found. Small necroses with plasmocytic reactions were observed. In the kidney parenchyma depositions were noted in the adventitia of the vessels, with intimal proliferations and thrombotic deposits. Three of the cases reported had developed squamous cell carcinoma. The authors describe the histological findings in the 4 cases reported and recommend removal of any kidney that shows evidence of ThO_2 deposition, regardless of lack of clinical and radiological signs of malignant tumor development. References cited, 50. (TSS)

22672 RADIATION AND LIFESPAN. Lindop, Patricia J. (St. Bartholomew's Hospital Medical Coll., London). Sci. Basis Med.: Annu. Rev., 91-109 (1965).

Qualitative and quantitative aspects of the life-shortening effect of ionizing radiation in mammals are reviewed. Of the qualitative aspects the main question concerns the nature of the life-shortening lesion; whether it is due to a specific effect of radiation in increasing the incidence of a neoplastic condition, such as leukemia, which causes death at an earlier age, or whether it is a nonspecific action, a premature or accelerated aging effect. Of the quantitative aspects, it is most important to establish the exact relation between the amount of life shortening and the dose of radiation. At present, information on this dose-response relation is available only for higher doses. Analysis of data on the effect in mice shows that the specific life shortening depends on numerous parameters, including radiation quality, dose, dose rate, and strain of animal species. The radiation quality may influence the life shortening effect through the difference in RBE. There is an increase in the life shortening effect by ~60% when the dose rate is increased from 20 to 500 rad/min. This variation, which is similar to that observed for acute effects, is probably due to a partial repair of the injury when the dose is delivered at a low rate. (TSS)

22673 TWO CASES OF RADIATION DAMAGE TO THE GROWING DENTITION AND THEIR SUPPORTING STRUCTURES IN CHILDREN. Fronman, S.; Ratzkowski, E. (Hadassah Univ. Hospital, Jerusalem). Dent. Pract. Dent. Rec., 16: 344-8 (May 1966).

The adverse effect of irradiation on the development of the dentition was demonstrated in 2 girls, one treated for cavernous hemangioma and the other for Hodgkin's disease. The child with hemangioma at the age of 2 yr and 2 months received x ray and Ra treatment in order to influence the extension of the hemangioma to the tongue. The accumulated doses from all fields was estimated as about 2500 to 3000 rad. Six yr after initial treatment, the irradiated skin and lip were atrophic, the mucosa of the mouth showed telangiectasis, and the right ear did not develop properly. Biopsy taken at the time of extraction of teeth revealed some spicules of bone in active osteogenesis, while others were osteonecrotic. The bone marrow was partially fibrotic and there were small foci of chronic inflammation. At age 8½ yr, routine examination revealed cicatrization of lower lip and atrophic skin of the jaw and neck. Growth malformations of the right ear and the jaw were found. The roots of the lower incisors were narrow, short, and tapering. The pulp canals were narrow, and the roots of the lower right permanent molar were short and tapering as compared to those of the left permanent molar, but the latter, as well, were small and short in comparison with normal lower first permanent molars. Treatment in Case 2 was given partly by 250-kV x ray, partly by ^{60}Co. The subsequently calculated dose to the left jaw from all treatments was 1800 to 2000 rad. Seven yr later, x ray revealed stunted roots of the second permanent molar. Furthermore, short narrow roots of lower left premolars, shortened roots of the first permanent molar, almost total failure of development of roots of the second permanent molar, and absence of third permanent molars on the left side were found. Widening of periodontal membrane of the left side as well as coarser bone round the permanent molar was noted. Failure in development of cortical height of the alveolar bone of the left lower molar region was evident. Pulp chambers were of normal size. (TSS)

22674 SYNGENEIC PREFERENCE AND ALLOGENEIC INHIBITION. Hellstroem, K. E.; Hellstroem, I. pp 79-93 of Isoantigens and Cell Interactions. Palm, Joy (ed.). Wistar Institute Symposium Monograph No. 3. Philadelphia, Wistar Inst. Press, 1965.

Preferential growth of tumor cells in homozygous mice of the tumor strain, as compared to various genetically compatible F_1 hybrids, was demonstrated in experiments using irradiated recipients or donor cells. The growth difference was detected as a higher tumor frequency and a shorter latency period in syngeneic hosts. Two terms were introduced to describe this situation, viz. syngeneic preference and allogeneic inhibition, of which the latter term is preferred since it implies the nature of the phenomenon. Allogeneic inhibition was demonstrated with lymphoma, sarcoma, and carcinoma cells. It was not possible to either strengthen or abolish the phenomenon by pretreating F_1 hybrid recipient mice with homozygous tumor cells or normal cells of the tumor strain, nor was it possible to abrogate allogeneic inhibition by preirradiating the recipients with 450 R. A growth inhibitory effect of admixed F_1 hybrid spleen cells, which had been preirradiated with 1000 R could be demonstrated in experiments with lymphoma lines, if phytohemagglutinin was added. The growth inhibition was abolished when the spleen cells had been treated with specific H-2 antibodies. Thus allogeneic inhibition is due to exposure of the grafted tumor cells to foreign isoantigens in heterozygous F_1 hybrid hosts. The nature of allogeneic inhibition was discussed and the hypothesis introduced that allogeneic inhibition may function as a surveillance mechanism capable of eliminating cell variants whose surface differs from that of surrounding cells within a given tissue. (BBB)

22675 INFLUENCE OF DIETS WITH A DIFFERENT UNSATURATED FATTY ACID CONTENT ON THE GLYCOGEN LEVEL IN THE LIVER OF RATS AFTER SINGLE AND REPEATED IRRADIATION WITH 600 R. Nemec, R.; Laginova, J. (Inst. of Oncology, Bratislava). Cesk. Gas. Vyziva, 20: 325-30 (1966). (In Czech).

Wistar rats weighing 150 to 170 g were maintained for 21 days before irradiation (180 kV x rays for acute, 600-R doses, or chronic exposure, 6 doses of 100 R each) on diets low or high in unsaturated fat. The rats were examined for changes in the glycogen level in the liver and survival of the animals, as well as the value of the diets in the prevention of radiation sickness. The best protective effect was produced by diets with a low unsaturated fatty acid content (olive oil and pork fat). Diets with a high content of these acids were less effective (margarine and sunflower oil). In animals on the diet containing olive oil and pork fat, the liver glycogen level was higher, not only under normal conditions but also after irradiation, as compared with those on diets containing margarine and sunflower oil. Chronic irradiation reduced the liver glycogen content more markedly than a single dose of 600 R. The min glycogen level in the rats given 6 100-R doses was ~1/10 the control level compared to only ~½ in the rats given a single 600-R dose. (BBB)

22676 THRESHOLD LESIONS IN RABBIT RETINAS EXPOSED TO PULSED RUBY LASER RADIATION. Kohtiao, A.; Resnick, I.; Newton, J.; Schwell, H. (New York Eye and Ear Infirmary, N. Y.). Amer. J. Ophthalmol., 62: 664-9 (Oct. 1966).

Threshold levels of laser radiation for the production of retinal lesions were determined in rabbits using the regular pulsed ruby laser and the Q-switched (spoiled) ruby laser, both having a radiation wavelength of 6943 Å. With an image size of the laser beam of 0.25 mm, the near-threshold lesion size was about 0.12 nm. As the energy of the laser beam decreased the lesion became smaller in size, eventually disappearing altogether. The near-threshold lesion 24 hr after exposure to the Q-switched laser was seen clinically as a faint circumscribed whitish area with underlying choroidal blood vessels visible. The lesion usually appeared an hour or more after exposure and healed usually within a week, with no visible evidence of injury. Histologic sections made several hours after exposure revealed moderate edema of the retinal layers and vacuolization and dispersion of the pigment granules in the pigment epithelium. No coagulum was present in the suprachoroidal space, but early infiltration of round cells was seen in the underlying choroid. The LF_{50} (lesion factor for 50%) representing the energy level at which 50% of the time a lesion is produced, for the pulsed ruby laser was about 0.8×10^{-4} J and for the Q-switched laser about 2.2×10^{-4} J. Equal energy from the regular pulsed ruby laser and from the Q-switched laser did not produce equal effects. The Q-switched laser required about 50 times less energy to produce a lesion as did the regular pulsed laser. The Q-switched pulses were about 80 nsec in duration whereas the regular pulsed laser was about 0.5 msec in duration. (BBB)

22677 THE INFLUENCE OF HIGH DOSES OF RADON ON OSMOTIC RESISTANCE OF HUMAN ERYTHROCYTES. Gies, Bernard (Forschungsinstitut Gastein, Oesterreiche Akademie der Wissenschaften, Bad-Gastein, Austria). Fun. Balneo-Bioclimatol., 3: 213-22(1965). (In German).

Human erythrocytes were suspended in Rn-containing physiological saline and were tested for their osmotic resistance, after various incubation times. No effect of Rn up to a dose of 2180 rad was noted. However, after a dose of 4900 rad a decrease of osmotic resistance was observed. This value is near the threshold of the dose of 6000 rad as reported by Leichti and Wilbrandt for the diminution of the osmotic resistance of human red blood cells by x irradiation. Suggestions in the literature for a protective effect of Rn at low concentration against hemolysis of osmotic origin could not be confirmed. Nor was there any justification of an effect caused by the β and γ radiation emitted by the disintegration products of Rn different from that caused by α radiation. Concepts of balneotherapy with Rn-containing mineral water based on beneficial effects of radiation at the cellular level are critically examined. (BBB)

22678 THE LASER OPHTHALMOSCOPE COAGULATOR: A PRELIMINARY REPORT. Ingram, H. Vernon. Trans. Ophthalmol. Soc. U. K., 84: 453-67(1964).

Lesions produced in rabbit eyes by a ruby laser beam are described. Optimal results in the rabbit were produced by energies between 0.19 and 0.39 J (400 to 600 J input). The threshold value was 0.039 J. A beam of 0.11 J produced discrete areas about 0.1 mm in dia, which were ideal for macular applications. The animals experienced no discomfort and there was no suggestion of photophobia. In none of the experiments was any clinical or histological evidence of damage to the cornea, lens, or vitreous found, and even rapid pulsing of the laser did not produce any thermal buildup in the vitreous. Sections of the lesions at varying times after treatment with the laser beam showed that the disturbance was strictly limited to the ares of choroid and retina to which it was applied. Firm adhesion developed in 1 week. Examination of sections made immediately after exposure showed swelling of the fibers with separation of the layers of the retina. There was cellular disorganization without cellular destruction. There was some dilatation of the terminal capillaries in the choroid, but no vessel proliferation, nor was there an increase in the cellular contents of the lumen. The sclera remained unchanged after the laser application. (BBB)

22679 THRESHOLD OF THE RETINA TO DAMAGE BY LASER ENERGY. Campbell, Charles J.; Rittler, M. Catherine; Noyori, Kimiharu S. (Columbia Univ., New York). Arch. Ophthalmol., 76: 437-42(Sept. 1966).

The laser energy required to produce lesions in the retinas of rabbit and human eyes just detectable by ophthalmoscopy was determined. Results obtained with a ruby laser indicated that immediately after treatment lesions were apparent when the energy value was or exceeded 2.7×10^{-4} J. For data obtained 48 hr after treatment, the energy necessary to produce a detectable coagulation was significantly lower, 2.1×10^{-4} J. Characteristic retinal lesions produced by the ruby laser at near threshold energy values were gray, disc-shaped, and often difficult to detect. They were similar in appearance in both rabbit and human subjects. The energy values necessary to produce a threshold lesion were significantly lower in rabbits than in human subjects, and in one human subject the threshold was lower in the macula than in other areas of the retina. The lowest thresholds for both rabbits and humans were found 24 to 48 hr after exposure. The lower threshold in the macular region by a factor of 2.5× appeared to be largely the result of greater energy absorption in that area due to greater and more uniform pigmentation. Differences not only in pigmentation but also in transmission by the ocular media may explain the discrepancies between the threshold values for rabbits and the human macula. (BBB)

22680 MORPHOLOGICAL AND CYTOCHEMICAL CHARACTERISTICS OF CELLS ACCOMPLISHING GRAFT-VERSUS-HOST REACTION UNDER TRANSPLANTATION OF THE ALLOGENEIC BONE MARROW TO X-IRRADIATED DOGS. Samoilina, N. L.; Totskaya, A. A.; Chertkov, I. L. (Central Inst. of Haematology and Blood Transfusion, Moscow). Tsitologiya, 9: 379-87(Apr. 1967). (In Russian).

Some data of morphologic, electron microscope, and cytochemical studies of the cells of transplantation immunity obtained from blood of supralethally X irradiated dogs at 6 to 8 days after bone marrow allografting are described. Differentiation of these cells from hyperbasophilic blasts up to mature lymphoid cells of distinctive appearance was followed. There were many free ribosomes in the cytoplasm of blast cells. The granular endoplasmic reticulum was not developed. The very beginning steps of differentiation were accompanied by activating the Golgi apparatus and appearance of lysosomes. In cells at all the stages of differentiation autophagic vacuoles were observed. The mature cells degenerated and died. Cell immunity mechanisms are discussed in the light of the data received. (auth)

22681 OBSERVATIONS ON VIRAL, CHEMICAL AND RADIATION-INDUCED MYELOID AND LYMPHOID LEUKEMIAS IN RF MICE. Upton, A. C.; Jenkins, V. K.; Walburg, H. E. Jr.; Tyndall, R. L.; Conklin, J. W.; Wald, N. (Oak Ridge National Lab., Tenn.). Nat. Cancer Inst. Monogr., No. 22, 329-47(Sept. 1966).

Mice of the RF strain, which are unusually susceptible to the induction of myeloid leukemia by ionizing radiation, were used to study the induction of leukemias and related growths by radiation, chemicals, and viruses. Whole-body irradiation early in life advanced the onset of thymic lymphomas, and to a lesser extent other neoplasms of reticuloendothelial origin in RF mice. The changes in age distribution were dependent on dose but did not affect all of these types of neoplasms to the same extent, the age-specific death rate from thymic lymphoma and from myeloid leukemia being affected more markedly than that from the other types of lymphomas and leukemias. Treatment with nitrogen mustard, triethylenemelamine, or Myleran also markedly increased the incidence of myeloid leukemia, or thymic lymphoma, or both, depending on their age, sex, microflora, and physiological state when treated, as well as on the conditions of treatment. Urethan, with or without irradiation, did not affect the incidence of either disease. Myeloid leukemias induced by irradiation were serially transmitted in adult and newborn recipients by cell-free extracts. Such extracts also increased the incidence of thymic lymphomas. Reticulum cell sarcomas alone were induced by the Rauscher virus. In general, females were less susceptible to the induction of myeloid leukemia than males, which may be attributable at least in part to the effects of estrogen since this hormone inhibits viral transmission of the disease. Germfree mice appeared less susceptible to the induction of myeloid leukemia by irradiation than conventionally reared mice, but were no less susceptible to induction of thymic lymphomas. It is concluded that a complex interaction among host factors and extraneous agents determines the incidence, latency, hematologic type, clinicopathologic features, and transmissibility of murine leukemia in RF strain mice. (BBB)

22682 SEROLOGICAL ANALYSIS OF ISOANTIGENIC VARIANTS FROM MOUSE TUMORS HETEROZYGOUS AT THE H-2. Ozer, Harvey L.; Klein, George; Ozer, Joy H. (Karolinska Institutet Medical School, Stockholm). pp 73-8 of Isoantigens and Cell Interactions. Palm, Joy (ed.). Wistar Institute Symposium Monograph No. 3. Philadelphia, Wistar Inst. Press, 1965.

It is possible to isolate variants from tumors heterozygous at the H-2 locus in mice by growth in either one of the parental strains. In most cases, particularly when pre-immunized hosts are used, these variants can be shown by serological tests to have lost the antigens against which the recipient is capable of reacting. Radiation experiments were conducted in 5 mouse strains in attempts to clarify the possible underlying mechanism of variant formation in vivo and to determine whether this approach could be utilized in genetic analysis. The behavior of an antigen (H) linked to both D and K but not selected against in hosts reactive against D or K alone was investigated in an A X A.SW lymphoma LNSF. Prior to serological analysis by absorption, the tumors were inoculated into newborn mice which did not contain the antigen to be tested. These mice were inoculated within 24 hr of birth and within 1-2 hours of receiving 400-R x irradiation. Tumors were tested for the presence of the respective antigens either by direct reaction or by absorption using erythrocytes or normal lymphoid cells as the target. The parent LNSF tumor readily gave rise to variants in A.SW X DBA/2. LNSF and the variants selected in A.SW X DBA/2 (DS variants) readily grew in A.SW, pre-immunized A.SW, and A.SW X C57BL/K1 hosts but not in a A.SW X C3H although all would be expected to select for comparable antigenic losses. The variant selected in A.SW X C3H (HSA) grew in all A.SW and A.SW F_1 hosts. The data demonstrated that under appropriate selective conditions segregation of antigenic specificities can occur, that the sequential antigen analysis of such variants is consistent with that of meiotic recombinants, and that such studies can be valuable in analyzing the genetic control of the H-2. (BBB)

22683 RUBY LASER EFFECTS ON THE MONKEY EYE. Jones, Arthur E.; McCartney, Alan J. (Army Medical Research Lab., Fort Knox, Ky.). Invest. Ophthalmol., 5: 474-83(Oct. 1966).

The eyes of 7 monkeys (Macaca cynomolgus and Cercocebus torquatus atys) were exposed to laser pulses of 2-msec duration with energy levels from 5 to 250 J. Laser pulses of moderate energy but of large retinal subtense produced different retinal

lesions from the clinical type after exposure at high energy density and small retinal subtense. A retinal photocoagulation that led to a satisfactory retinal adhesion was characterized by sharp boundaries, coagulation necrosis of the entire retinal exposure area, and migration of pigment into the injured area. A low energy density retinal burn of large retinal area was frequently not visible ophthalmoscopically. Histologically, the lesion was not demarcated by sharp boundaries, little coagulation necrosis was seen, and eventually the entire retina became involved. Pulsed ruby laser radiation was presented in Maxwellian view to the intact monkey eye. Gross damage to the globe was characterized by corneal pitting, lenticular disruption, bubbles and hemorrhage in the vitreous, and loss of light reflex. Energy levels above 100 J produced a marked degree of periorbital edema. Histological observations revealed extensive primary damage in the pigment epithelium and choroid and secondary retinal detachment and degeneration peripheral to the area exposed. Progressive retinal detachment and dedifferentiation secondary to the laser lesion occurred for a considerable time postexposure. (BBB)

22684 SIDE-REACTIONS FROM RADIOTHERAPY AND THEIR TREATMENT. Umegaki, Yoichiro. Naika, 14: 1221-8(Dec. 1964). (In Japanese).

The side-reactions accompanying radiotherapy include both general and local reactions. The general side-reaction is injury to blood-forming tissues in which abnormalities such as a decrease in leukocytes, thrombocytes, and red blood cells are found. After irradiation, such symptoms as nausea and vomiting are often observed. These may be due to the absorption or decomposition of products from destroyed cells. Abnormally high levels of blood urea, ammonia, and nitrogen can also be demonstrated. Inflammation of the skin and mucous membranes may occur after irradiation, and the necrotic tissues may be the cause of secondary infections. Disturbances of digestive system include diarrhea, loss of appetite, and peptic ulcer. Kidney and nervous disturbances may also be demonstrated. The treatment of irradiation injury can be summarized as consisting of general treatment which entails use of irradiation protective agents such as AET, symptomatic therapy for the nervous system by tranquilizers and antihistamines, digestive enzyme preparations, nutritional supplements (high-protein, high-calory diets, essential amino acids, vitamins B_1, B_2, B_6, B_{12}, C, K, and minerals), prevention of infection with antibiotics and sulfa drugs, and adrenal cortical steroids such as prednisolone. Local treatment for irradiation dermatitis includes the use of olive oil, adrenal cortical steroids, and antibiotic oi ments. (BBB)

22685 LESIONS CHARACTERISTIC OF SECONDARY DISEASE IN GERMFREE HETEROLOGOUS RADIATION CHIMERAS. van Bekkum, D. W.; de Vries, M. J.; van der Waay, D. (TNO, Rijswijk, Netherlands). J. Nat. Cancer Inst., 38: 223-31(Feb. 1967).

Germfree Swiss mice were given a lethal dose of x radiation and then treated with rat bone-marrow cells. A histologic study of the tissues of these mice at various intervals up to 80 days after irradiation revealed lesions in the lymphatic tissues, the skin, the intestinal tract, and the liver that were characteristic of graft-versus-host disease. In contrast to previous findings in conventional animals, these lesions were not complicated by inflammatory changes. (auth)

22686 RADIATION GYNOGENESIS IN SALMO IRIDEUS GIBB. Vassileva-Dryanovska, O.; Belcheva, R. (Inst. of Plant Physiology, Bulgarian Academy of Sciences). Compt. Rend. Acad. Bulg. Sci., 18: 359-62(1965).

Sex products of Salmo irideus Gibb. were treated with two doses of 50,000 R and 200,000 R γ radiation for 30 and 150 minutes. Inseminations of the ova were carried out with irradiated sperm 4.5 hrs postirradiation. A temperature shock was employed to obtain radiation gynogenesis. The percentage of fish that hatched in the control was 67.7%; sperm irradiated with 50,000 R, 5.1%; and sperm irradiated with 200,000 R, 0%. The period of hatching for the controls was 8 days and for the gynogenetically developing embryons, 12 days. There was no apparent difference between the 29-day embryos of the controls and those obtained with the 50,000 R irradiated sperm. It was concluded that the occurrence of specimens absolutely identical with the controls at this high rate of irradiation was an example of diploid radiation gynogenesis. The mechanism of this phenomenon is not given. (B.H.S.)

22687 A THROMBO-DENSITOGRAPHIC STUDY OF BLOOD COAGULATION IN CANCER PATIENTS FOLLOWING RADIOTHERAPY. Noto, V.; Micali, A.; Coglitore, G.; Rizzo, G. (Univ., Messina, Italy). Med. Nucl. Radiobiol. Lat., 8: No. 1, 103-15(1965). (In Italian).

Thrombo-densitographic curves were recorded after irradiation treatment in 20 cancer patients. Four of these patients were studied by the same method prior to radiotherapy; the findings indicated a biohumoral state of hypercoagulation. Results of the postradiotherapy tests revealed that irradiation caused a change in the state of hypercoagulation in the cancer patient towards the normal, and in some cases even to hypocoagulability. The theory was advanced that this effect on blood coagulation was proportional to or parallel to the dose of radiation that was administered. (auth)

22688 ULTRASTRUCTURAL STUDIES OF THE RETINAL LESIONS DEVELOPING IMMEDIATELY AFTER MASSIVE FOCUSSED IRRADIATION. Genovesi, E.; Micali, A.; Loreti, G. (Univ., Messina, Italy). Med. Nucl. Radiobiol. Lat., 8: No. 1, 117-27(1965). (In Italian).

An electron-microscopic study was made of the external segments of the retinal rods of rabbits, which were killed 2 to 3 hrs after focussed irradiation with ^{60}Co in a dose of 2000 R. Mostly, the ultrastructural changes encountered affected the external membrane, which in many places was disintegrated. It is suggested that this morbid-anatomical finding, which reveals an early involvement of the external segments, explains the pathogenesis of the post-irradiation phosphenes. (auth)

22689 SENSITIVITY TO HYPOXIA OF X-RAY IRRADIATED MICE. Shelkovnikov, I. A. (Military Medical Academy, Leningrad). Byull. Eksp. Biol. Med., 63: No. 3, 52-4(Mar. 1967). (In Russian).

Irradiated and control mice were "raised" to various altitudes to test their sensitivity to oxygen want in the initial stages of acute radiation disease. Mice that received 400, 600, and 800 R were less tolerant of high altitudes than the control group (statistically significant figures were obtained for mice irradiated with 400 and 800 R). Mice irradiated with 200 R were more resistant to altitude than intact animals. (auth)

22690 THE INFLUENCE OF OVARIECTOMY ON THE LIFE SPAN AND DEVELOPMENT OF BREAST TUMORS IN IRRADIATED RATS. Moskalev, Yu. I.; Streltsova, V. N.; Romanova, L. F. Byull. Eksp. Biol. Med., 63: No. 3, 107-10(Mar. 1967). (In Russian).

The influence of castration was studied in Wistar rats before and after irradiation (^{60}Co, 300 R) on the life span and incidence and rate of breast tumor growth. It was found that castration performed before or after irradiation increases the life span considerably and decreases the incidence and rate of growth of breast tumors in rats. Factors in the genesis of breast tumors are discussed. (TSS)

22691 CONCERNING MORPHOLOGICAL CHANGES IN THE BLOOD VESSELS OF THE GASTROINTESTINAL TRACT IN INJURY WITH RADIOACTIVE CERIUM. Lebedeva, G. A. Arkh. Patol., 29: No. 2, 30-5(1967). (In Russian).

An investigation was made of the morphological changes in the arteries and veins of the gastrointestinal tract of rats following administration of ^{144}Ce (9.12 and 15 microcurie/g) into their stomach through a gastric tube. There occur phasic morphological lesions in the vessels bearing dystrophic and sclerotic character. There was a considerable rise in the incidence of spontaneous vascular affections, the periods of their origination being decreased. Vascular lesions are usually segmental in character. The most profound changes were observed at 2-26 months in the arteries of the large intestine, which in the given experimental conditions was subjected to the greatest irradiation. Marked vascular lesions occurring at the remote period may play an important role in the development of the pathological process in the intestine, maintaining protracted intestinal ulcers. (auth)

22692 CONDITION OF BONE MARROW HEMOPOIESIS FOLLOWING REPLACEMENT TRANSFUSIONS OF POSTMORTEM BLOOD OF IRRADIATED ANIMALS. Ryzhkov, S. V.; Chesnokov, P. T.; Krylova, G. P. Probl. Gematol. Pereliv. Krovi, 12: No. 4, 48-51(Apr. 1967). (In Russian).

Transfused blood was obtained soon after general irradiation (in a dose of 500 R) and death of the dogs from mechanical asphyxia. Puncture material from bone marrow, ribs and peripheral blood was examined prior to the experiment, as well as on the 1st, 5th, 10th, 15th and 30th day after, the blood transfusion. Unitypical changes in the bone marrow hemopoiesis principally followed transfusions of postmortem blood of irradiated and nonirradiated animals. Still after transfusion of blood obtained from irradiated animals a compensatory proliferation of the red series began earlier and still continued at the termination of the observation period. Postmortem blood of irradiated animals produced a more pronounced irritating effect on the bone marrow. Experiments were carried out on 40 dogs. (auth)

22693 ALTERATIONS OF THE CONJUNCTIVO-LACRIMAL SECRETION AFTER IRRADIATION WITH THERAPEUTIC DOSES. Genovesi, E.; Micali, A.; Noto, V. (Univ., Messina, Italy). Med. Nucl. Radiobiol. Lat., 7: 359-68(1965). (In Italian).

A study was made of the alterations of certain component elements of the conjunctivo-lacrimal secretion after irradiation of the lacrimal gland with doses corresponding to those used in radiotherapy. In two groups of rabbits, one treated with contact irradiation and the other with ^{60}Co irradiation, a progressive decrease of the total globulins, of the gamma globulins, and of the pH could be observed, whereas the percentage of the albumins increased. In conclusion it is stated that in the pathogenesis of the ocular complications encountered after irradiation of foci in the vicinity of the eyeball, a part is played by the decrease of the gamma globulins and of the lysozyme in the secretion produced by the irradiated lacrimal gland. (auth)

22694 FURTHER STUDIES ON RAPIDLY DECREASING RECOVERY PROCESSES IN X-IRRADIATED SKIN. Grundner, H. G.; Rausch, L. (Univ., Giessen, Ger.). pp 141-9 of Biophysikalische Probleme der Strahlenwirkung. Muth, H. Stuttgart, Georg Thieme Verlag, 1966. (In German).

In investigations on rabbit ears the following conclusions were made. The O_2 supply in the rapidly occurring recovery after local x-irradiation plays no significant role. Rapidly occurring recovery processes can also be detected after fractionated irradiation. (tr-auth).

22695 DOSE-OUTPUT DEPENDENCE OF ACUTE RADIATION DEATH IN THE MOUSE. Heuss, K. (Max-Planck-Institut fuer Biophysik, Frankfurt am Main). pp 150-5 of Biophysikalische Probleme der Strahlenwirkung. Muth, H. Stuttgart, Georg Thieme Verlag, 1966. (In German).

The relationship between total dose and dose output in the acute radiation death of mice was investigated by a comparison of the mean survival and the mortality distribution. A group of animals exposed to a total dose of 1,200 R at a dose output of 1 R/min had the same mean survival time and mortality distribution as a second group which was irradiated at a dose output of 800 R/min for a total dose of 700 R. The extended radiation appeared to give the organism a chance for partial recovery from the irradiation. Therefore the dose was divided into a reversible and an irreversible fraction. (J.S.R.).

22696 EFFECT OF SMALL DOSES OF CARRIER IODIDE UPON THE ORGANIC BINDING OF RADIOACTIVE IODINE BY THE HUMAN THYROID GLAND. Stewart, R. D. H.; Murray, I. P. C. (Univ. of New South Wales, Kensington. Prince of Wales Hospital, Randwick, Australia). J. Clin. Endrocrinol. Metab., 27: 500-8(Apr. 1967).

The effect of small doses of carrier iodide (^{127}I) upon the organic binding of radioactive iodine (^{131}I) by the thyroid gland has been studied by performing 123 perchlorate discharge tests in normal persons and patients with abnormal thyroid function. In 86 tests, 100–2000 μg ^{127}I was given with the IV ^{131}I dose; the remaining 37 tests without carrier served as controls. In 60 of the 86 tests in which carrier iodide was administered, there was a positive perchlorate discharge of ^{131}I from the thyroid gland, indicating that organic binding of iodine was impaired. In the 37 control tests, perchlorate discharge was observed only in 2 patients with untreated thyrotoxicosis. Although there was considerable individual variation, the minimum carrier dose of ^{127}I required to cause demonstrable block of organic binding in normal persons appeared to be of the order of 750 μg, which resulted in a serum iodide level of 30 to 38 $\mu g/l$. However, a positive perchlorate discharge was observed in 1 of 3 TSH-treated normals given only 350 μg ^{127}I (serum iodide concentration 15 $\mu g/l$), in 4 of 7 patients with nontoxic goiter given 500 μg ^{127}I (serum iodide concentration 18–28 $\mu g/l$), in 6 of 7 patients with untreated thyrotoxicosis given 125–250 μg ^{127}I (serum iodide concentration 7–15 $\mu g/l$) and in 7 of 11 patients with thyrotoxicosis treated by radioactive iodine or thyroidectomy given 100–250 μg ^{127}I (serum iodide concentration 7–17 $\mu g/l$). Analysis of all the results showed a significant correlation between perchlorate discharge value and serum iodide concentration. This correlation was also present in the normal individuals, the TSH-treated normals, the patients with nontoxic goiter and those with untreated thyrotoxicosis when these diagnostic groups were considered separately. Inhibition of organic binding of iodine by the thyroid has been demonstrated with smaller carrier doses of iodide than has previously been recognized, and the results indicate that the presence and degree of block in organic binding is to a considerable extent dependent upon serum iodide concentration. The increased sensitivity of the patients with abnormal thyroid function to iodide inhibition is probably due to a higher thyroid/serum concentration gradient for iodide in these individuals. (auth)

22697 EFFECT OF X IRRADIATION ON INCORPORATION OF LEUCINE-1-^{14}C INTO THYMUS NUCLEAR FRACTIONS. Herranen, Ailene; Brunkhorst, Willa K. (Worcester Foundation for Experimental Biology, Shrewsbury, Mass.). Arch. Biochem. Biophys., 119: 353-5(Mar. 1967).

The effects of whole-body x-irradiation on the incorporation of leucine-1-^{14}C into nuclear fractions of the thymus gland of rabbits was investigated. Similar inhibitions of amino acid incorporation into two histone fractions and the soluble proteins of the nucleus were found. Inhibition was 21% at 4 hr and 48% at 6 hr postirradiation, respectively. Data revealed that a rather uniform inhibition of amino acid incorporation into all nuclear fractions isolated was present. With the acid extractable fractions there was greater inhibition in the 1 mM HCl extract and this fraction contained a high percentage of DNA. The 50 and 250 mM HCl extracts from control or treated nuclei did not contain DNA. (B.H.S.)

22698 RADIATION-INDUCED CASTRATION IN THE FEMALE TELEOSTEAN FISH, HETEROPNEUSTES FOSSILIS BLOCH. Srivastava, P. N.; Rathi, S. K. (Univ. of Rajasthan, Jaipur, India). Experientia, 23: 229-30(Mar. 15, 1967).

Female Heteropneustes fossilis Bloch (common Indian catfish) each weighing 13 ± 2 g were administered 5 μCi of ^{60}Co by intraperitoneal injection. Control fish received stable $CoCl_2$ in distilled water equivalent to the same dose. Two months after the first injection, the fish were given another dose of 5 μCi of ^{60}Co. The fish were sacrificed 4 mo after the first injection. The average weight of the ovary of an irradiated fish was 0.13 ± 0.02 g; in the controls, 1.5 ± 0.2 g. Histologically, control ovaries contained mature oocytes packed with yolk granules. In the ovaries of the irradiated fish, all of the oocytes remained in the perinuclear stage. The significant result of irradiation was complete castration that was brought about by the cessation of growth and further development of the oocytes. It was pointed out that irradiation may have disturbed the physiological activity of the pituitary gland and decreased the secretion of FSH. (B.H.S.)

22699 MITOCHONDRIAL ALTERATIONS BY RAYS. Dragoni, G.; Raimondi, L. (Univ., Milan. Univ., Pavia, Italy). Med. Nucl. Radiobiol. Lat., 9: 51-61(1966). (In Italian).

By means of electrophoretic techniques, a study was made of the effect of x-rays on the mitochondria of the livers of normal rats and of rats with ascites hepatoma. The irradiation was found to cause changes of the electrophoretic protein pattern in the mitochondrial structures of the liver cells; these are the manifestations of denaturation of proteins and probably also an increase in the lipid contents of the mitochondria. (auth)

22700 AN EXPERIMENTAL STUDY IN THE RAT OF THE LEUKOPENIC EFFECT OF WHOLE-BODY IRRADIATION AND OF TWO ALKYLATING DRUGS AFTER FRACTIONATED ADMINISTRATION. Schiavetti, E.; Baraldi, C. (Univ., Milan). Med. Nucl. Radiobiol. Lat., 9: 63-78(1966). (In Italian).

Albino rats were subjected to fractionated treatment with whole-body telecobalt irradiation and with the cytostatic agents Endoxan and Trenimon, at total doses corresponding to approx. one-third of the LD 50/30 for the rat; subsequently, a study was made of the leukocytary reactions, in their totality and with regard to the lymphocytary and granulocytary fractions. All three forms of treatment were found to result in very similar decreases of the leukocyte values; the similarity concerned the degree as well as the rate of progress of the decreases. However, once the treatment was discontinued, the values rapidly returned to normal. In the rats subjected to whole-body irradiation, the return to normal was somewhat slower and the pressure values remained practically the same while in the animals treated with the two cytostatic agents considerable fluctuations of the values could be observed in the course of the normalization process. The problem of the combination of chemo- and radiotherapy is briefly discussed. (auth)

22701 RADIATION STRESS IN EXPLOITED DAPHNIA POPULATIONS. Marshall, J. S. (E. I. du Pont de Nemours and Co., Aiken, S. C.). Contract AT(07-2)-1. Limnol. Oceanogr., 12: 154-8(Jan. 1967). (TID-22677).

A study was made of the effects of chronic, sublethal radiation stress, as modified by density-independent, nonselective exploitation, in laboratory populations of Daphnia pulex. Four exploitation rates (15, 40, 65, and 90%) were used at each of four radiation levels (3.7 to 5.1, 108 to 162, 270 to 375, and 468 to 684 R per day). Weekly examinations for 56 weeks included counting each population, nonselectively removing a fixed percentage, determining the total dry weight of the removed animals, and counting

the males, gravid females, embryos, and total number of animals in a sample of the population. Animals taken as yield were removed from well-stirred cultures. The entire population was distributed into spot-plate depressions for counting. Radiation dose rates were measured with dental film and a Victoreen ratemeter. The three highest radiation levels were obtained by placing the population at different distances from a 30-Curie ^{60}Co source. The lowest radiation levels were obtained on a shelf just outside the direct radiation beam. Except for minor fluctuations, the population exhibited three major cycles of fairly equal period within 56 weeks of observation. The major population cycles and minor fluctuations tended to occur simultaneously except in the populations subjected to the highest exploitation rate (90% per week) or radiation level (468 to 684 R/day). (S.M.H.)

22702 HEPATIC LESIONS PRODUCED BY 32 AND 55 MeV PROTON IRRADIATION. Ghidoni, John J. (Baylor Univ., Houston, Tex. Methodist Hospital, Houston, Tex.); Dalrymple, Glenn V.; Lindsay, Ian R.; Kundel, Harold L.; Haymaker, Webb; Ballinger, Edward. Arch. Pathol., 83: 370-6(Apr. 1967).

Depth-dose distributions of 32- and 55-MeV protons were qualitatively demonstrated in primate livers. Rhesus monkeys were irradiated through an 8 cm anterior port; one animal received 7,000 rads (surface dose) of 32-MeV protons and one received 6,000 rads (surface dose) of 55-MeV protons. The hemorrhagic lesions produced by protons of both energies were similar. However, that produced by the higher energy proton beam was present at a greater depth beneath Glisson's capsule (32-MeV proton, 0.5 to 3 mm; 55-MeV proton, 18 to 20.5 mm). Their respective locations were compatible with the calculated positions for the two Bragg peaks. Both lesions displayed extensive necrosis involving both the central and midzonal lobular regions accompanied by sinusoidal pooling of erythrocytes. The periportal zones contained a spectrum of degenerative cytologic alterations. (auth)

22703 THE PVP-^{131}I TEST IN PATIENTS EXPOSED TO IRRADIATION OF THE ABDOMEN. Sorrentino, R.; Cardinali, P. (Ospedale Maggiore, Novara, Italy). Med. Nucl. Radiobiol. Lat., 9: 1-20(1966). (In Italian).

The results on a study of the percentage of faecal excretion of PVP-I^{131} after intravenous injection in a group of 21 patients who suffered from tumours of the abdomen not affecting the digestive tract, and who were subjected to tele-cobalt treatment by various techniques are given. The purpose of this study was to find out whether the irradiation caused any alteration of the permeability of the intestines to proteins. Practically all the patients examined showed an increase of the protein permeability of the intestinal walls which was only of a moderate severity (although slightly less marked in the patients subjected to irradiation on large abdominal fields); the effects of this increased permeability on the protein balance was, however, negligible, as could also be concluded from the results of the numerous laboratory tests carried out in the same time. (tr-auth)

22704 FAILURE OF X-RAYS AND ACTINOMYCIN D TO PREVENT THE RESPONSE OF RENAL AND HEPATIC THYMIDYLATE KINASE TO THYMIDINE TREATMENT IN VIVO. Adelstein, S. J.; Kohn, H. I. (Harvard Univ., Boston). Biochim. Biophys. Acta, 138: 163-8(Mar. 29, 1967).

Thymidylate kinase activity was assayed in the supernatant extracts of liver and kidney from adult rats previously injected with thymidine. Prior X-ray and actinomycin D treatment did not affect the increased level of activity found 1 h after the deoxyribonucleoside was administered. Starvation up to 72 h also had little if any influence on the response to thymidine. Thus, the elevations of thymidylate kinase activity found after hepatectomy or thymidine injection are disparate in their reaction to X-ray and actinomycin D treatment. The thymidine response also differs from other substrate-responsive enzyme systems in rat liver. (auth)

22705 A CORRELATED GROWTH RESPONSE OF SPLEEN AND LIVER DURING THE GRAFT-VERSUS-HOST REACTION IN THE CHICK EMBRYO. Seto, Frank (Oak Ridge National Lab., Tenn.). Growth, 30: 257-62(1966). (ORNL-P-2220).

White Leghorn embryo recipients were inoculated with adult chicken spleen cells under various experimental conditions, and weights of the spleen, liver, thymus, and bursa of Fabricius were recorded. The extent of the liver enlargement was found to be directly correlated with the amount of splenomegaly elicited, dose of donor cells injected intravenously, and age of the embryonic hosts. The degree of splenomegaly was also influenced by the amount of donor cells injected and by the age of recipient embryos at the time of grafting. X irradiation of either donor spleen cells in vitro or host embryos, prior to the injection of cells, resulted in decreased splenomegaly. The corresponding liver data indicates parallel responses under the same experimental conditions. The greatest liver enlargement occurred in host embryos inoculated at 12 days of incubation and with lesser enlargement in older or younger recipients. As for the spleen, x irradiation of donor spleen cells and host embryos resulted in decreased hepatomegaly. The similarity in the enlargement responses of liver and spleen and the absence of such in the thymus and bursa, following the grafting of immunologically competent cells, suggest a common or related cellular reaction in the two organs. The results confirm earlier observations of an associated splenomegaly-hepatomegaly response and demonstrate a similarity in the growth kinetics of spleen and liver during the graft-vs-host reaction. No enlargement of thymus and bursa of Fabricius was observed. (BBB)

22706 LETHALITY AND MUTATION RATES AFTER X IRRADIATION OF FRESHLY LAID DROSOPHILA EGGS IN VARIOUS OXYGEN CONCENTRATIONS. Finsinger, Franz Xaver (Schweizerisches Serum-und Impfinstitut, Bern). Vierteljahrsschr. Naturforsch. Ges. Zuerich, 109: 175-95(Sept. 1964). (In German).

Eggs of Drosophila melanogaster that were 10 to 20 min old were irradiated in N/O mixtures with 1000 R of 50-keV x rays. The N/O mixtures contained 0, 2, 4, 8, 10, 21, or in 100% O). Embryonic mortality, postembryonic mortality, and the rate of recessive sex-linked lethal mutations were studied. The rates of all 3 effects increased in gas mixtures that contained from 0 to 10% O, but remained almost constant in atmospheres that contained from 10 to 100% O. The increased rates of embryonic mortality and lethal mutations observed in the O atmospheres, which reflected the ratio of the effect after irradiation in air to the effect after irradiation in N, amounted to 2.4. The analogous ratio for postembryonic mortality was lower. It was possible to show that various radiation effects that were induced within the same experiment, in spite of the same dose dependency, the same dependence on the O concentration, and the same ratio of increase due to the O concentration, were not caused by the same primary effects. (BBB)

22707 AN ATTEMPT TO SENSITIZE DROSOPHILA CHROMOSOMES TO X IRRADIATION AFTER 5-BROMODEOXYURIDINE INCORPORATION INTO DNA. Khan, A. H.; Alderson, T. (Cambridge Univ., Eng.). Drosophila Inform. Serv., 41: 135-6(Jan. 1966).

Substitution of 5-bromodeoxyuridine (BdU) for thymine in DNA enhances the sensitivity of cells of x irradiation. Using an aseptic and chemically defined culture medium, the radiosensitivity (for sex-linked recessive lethal mutations) of chromosomes of Drosophila larval spermatogonia was compared in the presence and in the absence of BdU. Drosophila does not utilize pyrimidine bases unless they are supplied as the nucleoside. To increase the chance of BdU incorporation, larvae were cultured in the presence of the folic acid analog, aminopterin, which inhibits thymine synthesis. A dose of 810 R of x rays was delivered at 180 R/min. Males and females were examined for sex-linked recessive lethals by the Muller-5 method using a single brood by mating individual males to two virgin females for 3 days, and, in the case of females, by mating individual females to two males for 3 days. When larvae were cultured in the presence of either deoxyuridine or BdU for 48 hr (with and without aminopterin), and followed by irradiation, or without irradiation, none of the sex-linked recessive lethal frequencies differed significantly from one another. There was no evidence for BdU-induced mutagenesis; and only a slight increase in mutation following x irradiation of males. There was no evidence for an increase in mutational radiosensitization of the x chromosome in the presence of BdU, nor was there evidence for BdU incorporation, although the BdU + aminopterin cultures slowed down larval development compared with the deoxyuridine + aminopterin cultures. (BBB)

22708 REPORT ON NEW MUTANTS. Puro, Jaakko (Univ., Turku, Finland). Drosophila Inform. Serv., 39: 64-5(June 1964).

Four Drosophila mutants are described that were produced by x irradiation of wild type male flies. Several other spontaneous mutants are also described. (TTS)

22709 THE EFFECT OF X IRRADIATION OF RABBIT SPERMATOZOA IN VITRO IN DIFFERENT GASES ON EGG DEVELOPMENT AND SPERM DEHYDROGENASES. Dott, H. M. (Animal Research Station, Cambridge, Eng.); Ishida, K.; Chang, M. C. J. Reprod. Fertil., 11: 485-7(1966).

The effect of the presence and absence of air on irradiation-induced changes in rabbit spermatozoa was examined. Semen was exposed to 800 R doses of x rays in air, oxygen, or nitrogen. After irradiation, 0.5-ml (50×10^6 spermatozoa) samples were inseminated into does which were then intravenously injected with 90 I = U of human chorionic gonadotropin to induce ovulation. The does were killed 2 or 6 days after insemination and the eggs recovered and

examined. The results showed that the insemination of spermatozoa after irradiation in vitro in the presence of air did not affect the proportion of eggs fertilized, but the number of normal blastocysts produced was distinctly reduced. Furthermore, neither the proportion of eggs fertilized nor the proportion of normal blastocysts produced was altered by replacing the air with either oxygen or nitrogen. This indicates that the damage suffered by spermatozoa at irradiation results from a direct ionizing action of x rays on DNA. When semen was incubated at 37°C with nitro-blue tetrazolium and appropriate substrates to demonstrate the dehydrogenase activity against succinate, ethanol, lactate, α-glycerophosphate, and glutamate, no difference was noted between spermatozoa from the irradiated and control samples. These results confirm that such doses of irradiation do not affect the metabolism of spermatozoa. (BBB)

22710 STUDIES ON THE SERUM PROTEINS OF CHIMERAS. I. IDENTIFICATION AND STUDY OF THE SITE OF ORIGIN OF DONOR TYPE SERUM PROTEINS IN ADULT RAT-INTO-MOUSE CHIMERAS. Phillips, Mildred E.; Thorbecke, G. Jeanette (New York Univ., New York). Int. Arch. Allergy Appl. Immunol., 29: 553-67(1966).

Evidence for the occurrence of donor-type immune globulins and transferrin was found in radiation-produced rat-into-mouse chimeras, as well as evidence for the synthesis of rat β_{1C}-globulin. The sites of origin of rat transferrin and β_{1C}-globulin in the chimeras and identification of the rat immune globulins were studied. The temporal development of donor-type protein synthesis in various organs was also analyzed. Rat-into-mouse chimeras were produced by intravenous injection of 2 to 8 $\times 10^7$ rat bone marrow cells within 4 hr after 750 to 1000 R whole-body x irradiation. The serum proteins of these chimeras were examined using absorbed antisera specific for rat or mouse serum proteins. Incorporation of ^{14}C-amino acid into serum proteins, identified by autoradiography of immunoelectrophoretic patterns from tissue culture fluids, was used to demonstrate synthesis in vitro. It was shown that rat transferrin and β_{1C}-globulin were produced by spleen and peritoneal macrophages, and rat immune globulins, γ_1, γ_2, and IgM by spleen and mesenteric lymph node. Production of transferrin and β_{1C}-globulin preceded that of immune globulins. Liver tissue produced mouse serum proteins only. The results showed that most of the established xenogeneic chimeras surviving secondary disease have a very active immune globulin production of donor type involving at least 3 different immune globulins. (BBB)

22711 STUDIES ON THE SERUM PROTEINS OF CHIMERAS. II. RAT GAMMA GLOBULIN FORMATION IN NEONATAL MICE WITH GRAFT-VERSUS-HOST REACTION INDUCED BY RAT SPLEEN OR THYMUS. Phillips, Mildred E.; Thorbecke, G. Jeanette (New York Univ., New York). Int. Arch. Allergy Appl. Immunol., 29: 568-74(1966).

To compare results concerning the donor-type serum proteins in postirradiation rat-into-mouse chimeras, experiments were conducted in neonatally established rat-into-mouse chimeras. To compare the effect of an immunologically competent adult tissue with a source organ of immune competent cells, the rat donor tissues used were spleen and thymus. These studies showed that a good correlation exists between the occurrence of donor-type γ-globulin in the chimeric animals, and the degree of graft-vs-host reaction induced as judged by assay of spleen indices. It was also shown that the amount and variety of donor type serum proteins observed in the sera of these neonatal chimeras is much less than in adult postirradiation chimeras. One of the sites of synthesis of rat immune globulins was shown to be the spleen. The optimal time for demonstration of immune globulin production in vitro by the chimeric tissue was 8 to 10 days after birth, and no rat immune globulin formation was demonstrated at 14 to 16 days, possibly due to rejection of the rat cells. The earlier detection of immune globulin formation of donor type in neonatal chimeras induced with spleen than in postirradiation adult chimeras induced with bone marrow was probably due to the greater immunological reactivity of spleen cells. (BBB)

22712 VASCULAR PERMEABILITY CHANGES IN INFLAMMATION. II. THE EFFECT OF LECITHINASE ANTAGONISTS IN ULTRAVIOLET INJURY IN THE GUINEA PIG. Logan, G.; Wilhelm, D. L. (Univ. of New South Wales, Sydney). Brit. J. Exp. Pathol., 47: 324-40(Aug. 1966).

Increased vascular permeability induced by both the α-toxin of Clostridium welchii and uv injury was investigated in the skin of the dorsal trunk of guinea pigs with circulating Evans blue dye. Relatively small doses of toxin induced a diphasic increase of vascular permeability, consisting of early and late responses, the latter being maximal in 2 hr. With larger doses, only a late response was induced, the peak effects developing in 3 to 4 hr. The α-toxin of C. welchii is a lecithinase and the late permeability response which is evoked was strongly suppressed in animals previously treated intraperitoneally with EDTA-Ca_2, and moderately decreased by single or multiple doses of the synthetic lecithin analog, 2,3-distearoloxypropyl(dimethyl)-β-hydroxyethylammonium acetate. In skin sites injured by uv radiation, on the other hand, the late permeability response was unaffected by prior treatment with either EDTA-Ca_2 or the lecithin analog. The results suggest that the late uv response was not mediated by a lecithinase. (BBB)

22713 REGENERATION OF THYMUS GRAFTS. II. EFFECTS ON IMMUNOLOGICAL CAPACITY. Miller, J. F. A. P.; De Burgh, P. M.; Dukor, P.; Grant, Gwendoline; Allman, Violet; House Winifred (Royal Cancer Hospital, London). Clin. Exp. Immunol., 1: 61-76(Jan. 1966).

To study the mechanisms by which thymus grafts restore immune capacities, experiments were performed on neonatally thymectomized mice bearing thymus grafts for limited periods. Syngeneic and allogeneic thymus grafts, and thymus tissue irradiated in vitro with 500 and 2000 R prior to implantation, were used. The grafts were excised after various intervals and the degree of restoration of immunological capacity in the thymectomized mice that had not received thymus implants had only $1/20$ as many antibody-plaque-forming cells per million spleen cells as sham-thymectomized controls and failed to reject foreign skin. Evidence of restoration of immune capacities was obtained in mice bearing for 1 to 2 weeks either normal thymus implants or thymus tissue irradiated in vitro with 500 R. In contrast, thymus tissue irradiated with 2000 R failed to influence neonatally thymectomized mice with respect to their immunological capacities. Most thymectomized mice bearing thymus implants, whether normal, irradiated with 500 or 2000 R, had normal blood lymphocyte levels. Cytological analysis of lymph nodes and spleen of mice bearing normal thymus implants revealed few thymus-derived cells but the proportion of these cells was significantly increased after specific immunization. No thymus-derived cells were, however, detected in lymphoid tissues of mice bearing irradiated thymus implants, not even in those capable of responding to antigenic stimuli. Thus the thymus plays an essential role in inducing the differentiation of immunologically competent cells from non-competent precursors and this function is dependent on the integrity of the thymus epithelial–reticular cells. (BBB)

22714 DETERMINANTS OF INFECTION IN THE PERITONEAL CAVITY. II. FACTORS INFLUENCING THE FATE OF STAPHYLOCOCCUS AUREUS IN THE MOUSE. Cohn, Zanvil A. (Rockefeller Inst., New York). Yale J. Biol. Med., 35: 29-47 (Aug. 1962).

The course of staphylococcal infection in the peritoneal cavity of the mouse was studied, the effects of bacterial endotoxin, cortisone, and x irradiation being employed to delineate the factors responsible for the intraperitoneal destruction of S. aureus. Simultaneous intraperitoneal administration of lipopolysaccharide and bacteria decreased to $1/10$ the number of organisms required to kill the mouse. This was correlated with a decrease in the number and functional activity of mononuclear cells of the peritoneal cavity, and with a delay in the influx of granulocytes from extraperitoneal sources. The intraperitoneal injection of endotoxin 48 hr prior to staphylococcal challenge resulted in the survival of mice subjected to an ordinarily lethal inoculum. Enhanced resistance presumably was the result of increased phagocytes in the peritoneal cavity and enhanced efficiency of phagocytosis. Large doses of hydrocortisone reduced the lethal dose of staphylococci to $1/100$ of that required in the normal mouse, while depressing the number of naturally occurring mononuclear cells of the peritoneal cavity to $1/10$ of the control value present in the unaltered mouse. Cortisone also inhibited the diapedesis of granulocytes, even though large numbers of these cells were present in the circulation, with no alteration in the over-all phagocytic activity of either mononuclear or polymorphonuclear leucocytes. Total-body x irradiation at a dose of 650 R resulted in a decrease to $1/10$ the number of staphylococci required to kill the mouse. No significant alteration of phagocytic function or numbers of naturally occurring mononuclear cells of the peritoneal cavity was noted. The major factor involved in increased irradiated host susceptibility was a reduction in circulating leucocytes and the subsequent influx of only a few cells. Neither the function nor rate of emigration of the granulocytes changed in the irradiated animal. (BBB)

22715 ACCELERATED GESTATION TIME IN THE SYRIAN HAMSTER FOLLOWING LOW DOSE X IRRADIATION. Vedral, Donald F. (Univ. of Cincinnati); Laing, William H. Chicago Med. School Quart., 26: 31-2(Spring 1966).

A comparative morphological study was made on the effects of low-dose x radiation on the embryo and fetus of the hamster. Three periods were stressed: the early stage of fertilization,

gestation, and the formative stage of fetal and placental development. An attempt was made to determine whether specific anomalous conditions could be predicted by irradiation in the early postimplantation stage. At day 1.5 post-coitus, hamsters were x irradiated with 5 R. Their bodies were shielded with a ¼ in. Pb channel which allowed exposure of only the total lower extremities and the pelvis 1 to ½ cm above the iliac crest. At day 10 post-coitus, control hamsters showed a mean body weight increase of 7.0 g, while in experimental hamsters the increase was 19.0 g. Gross inspection by a dissecting microscope revealed normal fetal maturation of body and organs in both the control and experimental hamsters. The remaining hamsters were examined following parturition. Results of gross and microscopic inspection of both experimental and control hamsters were normal. Following parturition the experimental litters were mated, and a normal 16.5-day gestational period was seen. Thus irradiation with low-dose x rays had no anomalous effects in hamster embryonic development, and transfer of genetic changes to siblings or offspring was not detected after one generation. The irradiation seemed to accelerate embryonic and placental development along a normal plane. (BBB)

22716 POLYMORPHOUS LIGHT ERUPTION. Epstein, John H. (Univ. of California, San Francisco). Ann. Allergy, 24: 397-405(Aug. 1966).

The pathologic reactions resulting from exposure of skin to uv radiation (2900 to 3200 Å) are reviewed with reference to the recent literature and evaluation of 84 patients. This survey indicated that the polymorphous light eruptions are characterized by a number of consistent clinical and histological features. The clinical patterns are pleomorphic or polymorphic in nature. Though the multiple small papular and eczematous reactions were by far the most common in the patients examined, large papules, plaques, and erythema multiform patterns occurred in many patients. Histologically, a variety of epidermal changes were noted depending on the clinical patterns. However, the dermal response was consistent and characteristic. This included dense perivascular lymphocytic infiltration, edema of the small blood vessel walls, and edema of the upper dermis. The disease generally began in adult life and ran a chronic course. The sex distribution was equal and the process was not limited to any racial group or pigment pattern. The clinical action spectrum, as confirmed by phototest studies, was confined to the sunburn range (2900 to 3200 Å). Experimental studies indicated that the process is not wavelength dependent and can be precipitated by any uv wavelength or energy source that will produce a delayed phototoxic type of erythema. Pathogenetically the clinical and histological patterns simulate those found in delayed contact allergy. (BBB)

22717 STUDIES ON LONG-LIVED SMALL LYMPHOCYTES IN THE RHESUS MONKEY AND SOME OTHER MAMMALS. Weber, W. T.; Nowell, P. C. (Univ. of Pennsylvania, Philadelphia). J. Reticuloendothel. Soc., 2: 326-42(Nov. 1965).

In an attempt to find an experimental system in which to study long-lived small lymphocytes, a search for such cells was made in the blood and various hematopoietic tissues of x-irradiated rhesus monkeys, swine, rabbits, guinea pigs, rats, and mice. The best results were obtained with the monkeys, and data on these animals are given in detail. Radiation-induced unstable chromosome aberrations in phytohemagglutinin-stimulated leucocyte cultures were used as markers to identify long-lived small lymphocytes capable of surviving for long periods in vivo without dividing. Such cells were found in the blood, spleen, and lymph nodes of rhesus monkeys up to 8 months after x irradiation; in irradiated pigs, rabbits, guinea pigs, rats, and mice only occasional long-lived cells were seen. In monkeys, acentric fragments and apparent dicentrics were more common than ring chromosomes or more complex rearrangements. In pre-irradiation control cultures, dicentrics and rings were not observed and acentric fragments were observed in less than 2% of cells. The highest incidence (26%) of cells with unstable changes was observed in peripheral blood cultures obtained 30 min following exposure. Frequency of cells carrying unstable aberrations had decreased markedly to 5 to 14%, and during the next 5 weeks these cells persisted at a low frequency (3 to 13%). In addition to these changes in diploid cells, abnormal polyploids were observed in monkeys after exposure to radiation. No stem lines with stable aberrations were seen in peripheral blood cultures of these monkeys, although an occasional cell (1 to 2%) with more than 42 chromosomes (the normal diploid number in the monkey) and carrying an extra acrocentric or metacentric was observed 2 to 7 months after exposure. (BBB)

22718 THERAPEUTICAL APPLICATIONS OF BLEEDING IN HAEMATOPOIESIS DEPRESSION STATES. Rosin, S.; Chinta, G. (Oncological Inst., Bucharest). Bibl. Haematol., 23: 1159-63 (1965).

A bleeding stimulus was used to increase the rate of regeneration of hematopoietic tissue in dogs, rabbits, and rats. Dogs received 450 or 600 R doses of x rays and were bled twice during the next 2-day period, 250 to 400 ml of blood being removed and replaced by saline. The 450 R irradiated and bled dogs had a leucocyte level higher than that in irradiated controls and similar to that of animals treated with autologous bone marrow. Anemia (1.5×10^6 erythrocytes/mm^3 for 3 weeks) was well tolerated. Blood cell restoration in bled dogs was completed 2 months after irradiation. In this interval the 600 R irradiated dogs presented a more severe change in the hematologic syndrome. The mobilization of reservoir-stored elements, estimated by the increase in circulating leucocytes following blood-loss, was less. Irradiated controls died at the same time, i.e., on the 14th postirradiation day. Beginning with the 24th day, bled dogs presented signs of improved general condition. Two months after irradiation, blood indices were normal. Animals were alive 13 months after irradiation. Rabbits, irradiated with 1000 R and bled, showed moderate leucopenia with an oscillating course up to the 25th postirradiation day. The decrease of erythrocytes by 20 to 40% was well tolerated. By 30 days after irradiation, though blood indices were low (leucocytes 4500/mm^3, erythrocytes 4 million/mm^3) the general condition of the animals was normal. They were still alive 15 months after irradiation, whereas controls died on the 5th to 21st day, showing bone marrow aplasia. With rats, after 800 R irradiation, 90% of the animals died within 30 days. Bled animals survived to a greater extent. The mitotic index of the bone marrow in bled, normal, and irradiated animals was not significantly higher than that in nonbled ones. However, bone marrow cellularity per volume units was higher. (BBB)

22719 SHORTENING OF THE SEGMENTATION TIME OF NEUTROPHIL GRANULOCYTES. Burrichter, M.; Fliedner, T. M.; Stodtmeister, R.; Fache, I. (Institut fuer Haematologie der Gesellschaft fuer Strahlenforschung, Freiburg i. B.). Schweiz. Med. Wochenschr., 95: 1520-3(Oct. 30, 1965). (In German).

Studies were made of the segmentation time of neutrophilic granulocytes exhibiting radiation-induced, mitotically evident abnormalities (giant cells with one or more abnormal nuclei). The segmentation time was defined as the time between the last mitosis of a myelocyte (or its radiation-induced inhibition) and the appearance of a segmented granulocyte. In rats, dogs, and man exposed to whole-body ionizing radiation, the segmentation time of granulocytes with mitotic abnormalities was found to be shortened by one-half to one-third as compared to segmentation time determined with the ^{3}H-thymidine method. Radiation-injured neutrophils do not consist of one population if the size and amount of nuclear material is taken as the criterion. Rather, it is possible to distinguish several populations appearing in marrow and blood in an orderly fashion, the smallest giant cells coming first and the largest giant cells appearing at 108 hr. These findings are in accordance with the hypothesis that the myelocytic proliferative pool consists of a series of compartments in which cell divisions can be prevented by radiation but in which cell maturation and release are unimpeded. (BBB)

22720 ADVANCES IN INSECT POPULATION CONTROL BY THE STERILE-MALE TECHNIQUE. Mehrotra, K. N.; Sethi, G. R. (Indian Agricultural Research Inst., New Delhi). J. Sci. Ind. Res., 25: 539-43(Dec. 1966).

The history and basic principles of the sterile-male technique for the eradication of insect pests are described. A critical evaluation of various methods for induction of sterility in insects and the aspects of nutrition concerned with mass rearing of insects are discussed. A brief account of research being performed in different parts of the world on various aspects of the technique is given and future lines of work are indicated. (78 references). (B.H.S.)

22721 REPRODUCTIVE PERFORMANCE OF A LABORATORY COLONY OF PEROMYSCUS POLIONOTUS. Williams, Roger G.; Golley, Frank B.; Carmon, James L. (Univ. of Georgia, Athens). Amer. Mid. Natur., 73: 101-10(Jan. 1965).

A laboratory of old-field mice (P. polionotus) was established to allow study of the effects of γ irradiation on growth and development. Four groups of animals were trapped on the AEC Savannah River Plant at Aiken, South Carolina. Before evaluation of the effects of radiation on this species, it was necessary to establish basic parameters of the population. Various aspects of growth and reproductive performance were chosen as attributes susceptible to change by γ irradiation. The reproductive performance of the unirradiated colony is reported, with emphasis on gestation period, litter size, sex ratio, frequency of pregnancy, and survival of young. To determine if these traits change in unirradiated animals under domestication, the reproductive performance of the wild-caught parents was compared with that of the first labora-

tory generation and with free-living wild mice. Fertility of males and females declined about 10% in the first generation born and raised in the laboratory as compared with the wild-trapped mice which formed the basis of the colony. Incidence of pregnancy, size of litter, and survival of young increased with domestication. Litter size was significantly larger in lactating compared with nonlactating mice and in the first-generation lactating females compared with wild-trapped lactating females. (BBB)

22722 IMMUNE RESPONSES IN SPLEEN COLONIES. II. CLONAL ASSORTMENT OF 19S- AND 7S-PRODUCING CELLS IN MICE REACTING AGAINST TWO ANTIGENS. Celada, F.; Wigzell, H. (Karolinska Institutet, Stockholm). Immunology, 11: 453-66(Nov. 1966).

Spleen colonies arising in x-irradiated mice pre-immunized with sheep and chicken erythrocytes were assayed for the content of 19S and 7S γ-globulin-producing cells. This was done by applying to each isolated colony a direct (19S) and an indirect (7S) plaque test for each antigen. Two-month-old (A X DBA) F_1 hybrid mice were given a 550 R dose of x rays to provide for spleen colony formation upon regeneration. The antigens, sheep and chicken erythrocytes, were inoculated intravenously, the first time 7, 5, or 4 days before irradiation (pre-immunization) and the second time (challenge) 7 days after irradiation of the mouse. In both tests, the positive anti-sheep or anti-chicken reactivity of cells was found to be completely independent of each other. The plaque-forming capacity for 19S- and 7S-producing cells showed a marginally significant association in the anti-sheep response only. The numbers of plaque-forming cells were distributed exponentially, suggesting that 19S- and 7S-producing cells have similar growth kinetics. The results confirmed the clonal nature of antibody response within spleen colonies, thus making the system amenable for genetic studies of antibody production. They documented a strictly vertical transmission of antibody specificity, and possibly of immunoglobulin class. The incomplete independence of 19S and 7S distribution was interpreted as due to local or technical conditions rather than to a production shift of the clones. (BBB)

22723 TUBERCULOID GRANULOMAS IN LYMPH NODES IRRADIATED FOR METASTATIC TUMORS. Shimasota, Yukio; Oboshi, Shoichi; Umegaki, Yoichiro (National Cancer Center, Research Inst., Tokyo). Acta Pathol. Jap., 15: 339-53(1965).

Cytologic changes in lymph nodes irradiated for cancer metastases were studied. Following irradiation, epithelioid cell granulomas, resembling those induced by micro-organisms, were encountered in cervical lymph nodes which were the site of metastases from nasopharyngeal noncornifying squamous cell carinomas. Tumor cells made necrotic by radiation were the source of granulomas which were distinguished from those caused by micro-organisms on the basis of structural remnants demonstrable in silver-impregnation preparations and occasionally recognizable in hematoxylin-eosin or trichrome stained sections. The ghosts of an alveolar arrangement in the zone of necrosis that were demonstrated excluded the possibility that the granulomas were the result of necrosis of normal lymph nodes because of irradiation. A relation was observed between the type of granuloma induced and type of malignant neoplasm. (BBB)

22724 EFFECT OF ROENTGEN-RAY IRRADIATION ON SYNTHESIS OF INFORMATION RNA IN THE EARLY EMBRYOGENESIS OF THE LOACH. Kafiani, K. A.; Timofeeva, M. Ya.; Neifakh, A. A.; Rachkus, Yu. A.; Mel'nikova, N. L. (Inst. of Molecular Biology, Moscow. Inst. of Morphology of Animals, Moscow). Biochemistry (USSR) (Engl. Transl.), 31: 319-24 (Mar.-Apr. 1966).

Translated from Biokhimiya, 31: 365-71(Mar.-Apr. 1966).

X irradiation in doses suppressing the morphogenetic activity of the nuclei inhibits the synthesis of the information (messenger) RNAs in loach embryos. The synthesis of the different sedimentation fractions of RNA is depressed practically equally. In the course of incubation of embryos after irradiation, the ability to synthesize mRNA varies with the stage of development at which irradiation took place: in embryos irradiated at the gastrula stage the synthesis of mRNA falls progressively, while in those irradiated at the stages of the blastula (5 to 9 hr), morula, and cleavage (from 1 to 5 hr) the initial inhibition of synthesis is succeeded by gradual activation. Since the activation of RNA synthesis in irradiated embryos is observed against the background of the almost total destruction or absence of the nuclei, it seems probable that it takes place as a result of extranuclear synthesis of RNA. (auth)

22725 BONE MARROW TRANSPLANTATION AND THE THYMUS. Pichlmaier, H. (Univ., Munich). Arch. Klin. Chir., 313: 723-7(Dec. 20, 1965). (In German).

Thymectomized adult dogs were x irradiated with 450 R of whole-body radiation. Nonirradiated autologous bone marrow cells were administered after irradiation. In the subsequent 2 or 3 weeks a 10% leukopenia resulted. Animals that received homologous kidney transplants rejected them within 4 to 8 days in spite of the absence of the thymus and the lymph cell deficit. Bone marrow cells were administered to 95 adult thymectomized rats 14 days after exposure to 800 R of whole-body x radiation. When in comparison to normal animals, the thymus appeared to have an important regenerative function for the white blood cell picture. Regeneration was proportional to the total number of bone marrow cells administered to the thymectomized, irradiated animals. Immunological effects were measured in terms of rejection of homologous skin tissue transplants. After administration of 10^7 marrow cells to nonthymectomized animals the granulocytes and lymphocytes reached their initial values within 8 and 21 days respectively. Homologous skin transplants were rejected within an average time of 26 days. In thymectomized irradiated animals given 10^8 marrow cells the granulocytes reached their initial value within 9 days, but the lymphocytes never reached the initial value. Transplant rejection time was about 28 days. In thymectomized irradiated animals given only 10^7 marrow cells granulocyte recovery required 20 days, and lymphocyte recovery was much slower. Tissue transplant rejection time was about 48 days. (BBB)

22726 EFFECT OF X-IRRADIATION ON THE NUMBERS OF SUPRABASAL DENDRITIC CELLS IN HUMAN EPIDERMIS. Peckham, M. J. (Institut Gustave Roussy, Villejuif, France); Riley, P. A. Brit. J. Dermatol., 78: 519-24(Oct. 1966).

Patients undergoing x-ray therapy were studied to test the prediction that agents which reduce either the mitotic rate or the motility of basal epidermal dendritic cells (melanocytes) cause a reduction in the numbers of suprabasal dendritic cells (Langerhans cells) in the epidermis. A relation existing between melanocytes and Langerhans cells has been proposed to the effect that melanocyte divisions are offset by transepidermal Langerhans cell migrations. The doses of 300 kV x rays ranged between 10 and 300 rad. Biopsies were taken at ½ hr, 24 hr, 48 hr, 72 hr, and 10-day intervals after irradiation. All samples of skin showed dense ATP reaction product in suprabasal cells and in dermal structures such as blood vessels and fibroblasts. Comparisons between irradiated and nonirradiated skin showed a slight reduction in ATPase activity in dendritic cells of the irradiated samples taken 1 and 4 days following exposure. A drop in the suprabasal dendritic cell counts was noted during a period of up to 10 days after a single small dose of x irradiations. The significance of the deviation from normal increased just after irradiation and the 10th-day values were below the 5% limit of probability. Some degree of recovery was shown in several sequentially tested patients between the 3rd and 10th days after irradiation. (TSS)

22727 THE SELECTIVE IRRADIATION OF CANINE LYMPH NODES BY MEANS OF INTRALYMPHATIC INJECTION OF ^{32}P. Chiba, Chiyo; Kondo, Mizuka; Rosenblatt, Melvyn; Wolf, Paul L.; Bing, Richard J. (Wayne State Univ., Detroit. Harper Hospital, Detroit). Transplantation, 5: 232-40(Mar. 1967).

Intralymphatic injection of radioactive chromic phosphate produced a severe destruction of a majority of lymph nodes and subsequent marked lymphopenia in dogs. Selectivity of radiation was evidenced by histological study of other major organs and blood counts. Antibody production of these animals against human serum albumin was significantly inhibited; however, the reactivity to the allografted heart was not altered. (auth)

22728 EFFECT OF X RADIATION ON LIPID COMPOSITION OF RAT SERUM AND LIVER. Angelico, Raffaele; Casparrini, Giuseppe; Cavina, Guido; Moretta Maggiore, Lucia; Quintiliani, Marcello. Ann. Ist. Super. Sanita, 1: 698-707(1965). (In Italian).

Changes in serum and liver lipids after whole-body irradiation with a single massive dose of x rays were studied in adult male Long Evans rats. The animals were fasted for 12 hours before irradiation, with intensity of 44 R/min, for a total amount of 1000 R. The fasting animals were killed 48 or 72 hours after the irradiation. Unirradiated rats, kept in the same condition, served as controls. A significant increase in total lipid content of the serum was observed either 48 hours or 72 hours after the irradiation, whereas liver lipids showed only minimal changes. The various factors of the serum lipids showed different changes. The hyperlipemia was mainly due to free and esterified cholesterol, phospholipids, and triglycerides which increased proportionally to the increase of total lipids; diglycerides and free fatty acids showed only minimal changes. Liver lipid modification consisted in a decrease of triglycerides and cholesterol. (tr-auth)

22729 NEW RADIOSENSITIZING COMPOUNDS ACTING ON RABBIT ERYTHROCYTES IRRADIATED IN VITRO. Bianchi, Maria R.; Strom, Enrica. Ann. Ist. Super. Sanita, 2: 342-8 (1966). (In Italian).

Chloro- and fluoroacetic acid, chloroform, trichloroacetic acid, and ethyl and sodium methanesulfonates enhance the response of rabbit erythrocytes irradiated in vitro with x rays. The radiation effects studied were the potassium loss from the cells immediately after irradiation and hemolysis 22 hours later. The sensitizing effect is absent when the substances are added to the red cell suspensions just after irradiation, or when they are washed out before irradiation. The results are in agreement with the hypothesis that sensitization is the result of damage to the red cells by the products of radiolysis of sensitizing compounds. (auth)

22730 CLINICAL CHARACTER OF TOLERANCE OF THE SKIN TO ELECTRON THERAPY AT 14 TO 32 MeV. Babini, L. (Univ., Bologna). Radiobiol. Radioterap. Fis. Med., 21: 307-19 (Sept.-Oct. 1966). (In Italian).

The alterations occurring in skin submitted to radiation therapy with electrons of energies varying between 14 and 32 Mev are described. After having stated that the course of early reactions is practically superposable to that obtained from 200-kev radiations, but delayed in time for about 2 weeks, the author dwells on late reactions, at times particularly serious, due to doses over 5000-5500 R administered on a single field, and points out that late reactions from electrons are not to be neglected in respect of those due to 200-kev x-rays. (auth)

22731 EARLY ULTRASTRUCTURAL ALTERATIONS IN PROXIMAL TUBULAR CELLS AFTER UNILATERAL NEPHRECTOMY AND X-IRRADIATION. Leak, L. V. (Massachusetts General Hospital, Boston); Rosen, V. J. Jr. J. Ultrastruct. Res., 15: 326-48(June 1966).

Female (C57L × A1 He) F_1 mice 12 weeks of age were whole-body irradiated or subjected to unilateral nephrectomy and after 4 hr exposed to 600 rad whole-body x irradiation. Electron microscopic examination of the proximal tubular cells in kidneys of irradiated mice showed marked cytoplasmic alterations after 48 hr. The cytoplasm contained hypertrophied smooth endoplasmic reticulum that appeared as tubular profiles which formed an interconnecting lattice that coursed throughout large areas of the cytoplasm. In unilaterally nephrectomized animals and animals exposed to x irradiation after unilateral nephrectomy, numerous whorl-like membranous structures occurred in the basal and medial cytoplasm of proximal tubular cells after 48 hr. These membranous structures apparently represent a substantial absolute increase in new membranes for these cells. Many dense lamellated granules composed of parallel alternating dense and light bands arranged in concentric arrays were observed in the apical and medial zones of the proximal tubular cells. The internal lamellar pattern of the dense granules was similar to the myelin figures which can be obtained from phospholipid-water systems. After 3 months the prominent cytoplasmic alterations were not apparent; however, numerous vacuoles containing large accumulations of lipid, along with many dense granules and filaments, appeared throughout the apical and basal cytoplasm of the proximal tubular cells. Adenomas appeared in some mice 12 to 18 months after uninephrectomy and irradiation. (BBB)

22732 RECENT RESEARCH ON THE PRODUCTION OF PULMONARY METASTASES. THE EFFICACY OF SMALL DOSE OF RADIOTHERAPY ADMINISTERED TO THE THORAX IN AN EXPERIMENTAL SYSTEM. Agostino, D. (Sloan-Kettering Cancer Center, New York). Nunt. Radiol., 31: 111-23(Feb. 1965). (In Italian).

Experiments on the effect of radiation on metastasis of cancer cells were performed in 385 female Wistar rats inoculated with Walker carcinosarcoma cells (in the ascites form) in the femoral vein. The thoracic region of the animals received 1000 to 1500 R doses of 250 kv x rays. Small doses of x rays (1000 R) delivered to the cancer cells in vivo 24 hr prior to inoculation did not alter the production of pulmonary metastases. The tumor nodules of these animals appeared also to be more numerous than those of other groups. Significant results were, however, obtained after the inoculation of irradiated cancer cells by irradiation of the chest of the animals. In vivo irradiated cancer cells were identified in the vena cava blood as being of larger size than those that were not irradiated. In the aortic blood, however, the irradiated cancer cells appeared to be of the same size as non-irradiated ones. The significance of these experimental findings to clinical radiotherapy techniques is discussed. (BBB)

22733 POLYPLOID CELLS IN HUMAN LEUKOCYTES FOLLOWING IN VIVO AND IN VITRO IRRADIATION. Ishihara, Takaaki; Kumatori, Toshiyuki (National Inst. of Radiological Sciences, Chiba, Japan). Cytologia (Tokyo), 31: 59-68(Mar. 1966).

Observations on radiation-exposed persons were performed in 6 Thorotrast-injected subjects, who had received an injection of colloidal solution of ThO_2 as a contrast medium about 25 yr earlier, and on 5 out of the 23 fishermen who were exposed to fallout at Bikini 10 yr earlier. For the in vitro irradiation studies, venous blood obtained from a healthy male was exposed to ^{60}Co for doses of 50, 100, 200, and 350 R. For both in vivo and in vitro material, the incidence of polyploid cells was determined in leukocyte cultures. Polyploid cells were markedly more frequent in the radiation-exposed subjects than in the normal ones. A high frequency of polyploid cells was also obtained in leukocytes cultured from blood irradiated in vitro, and the frequency increased with the dose of radiation. Most of the polyploid cells contained abnormal chromosomes such as dicentrics, tricentrics, rings, and acentric fragments, the dicentrics being the most frequent in occurrence. The frequency of polyploid cells showing chromosome abnormalities increased with the dose of radiation. Often the abnormal chromosomes were present in pairs, as a set of 2 morphologically identical chromosomes, in most cells in the tetraploid range; whereas they occurred in 2 pairs in cells in the octoploid range. It is suggested that the polyploid cells might have originated from cells with abnormal chromosomes, such as dicentrics, which may have interfered with cell division, the distribution of chromosomes to the daughter cells being blocked after chromosome replication. In the Bikini subjects, polyploid cells having no abnormal chromosomes were seen frequently. It is likely that genetic losses in a cell may be another factor inducing polyploidy. (BBB)

22734 STUDY OF THE BLEEDING TIME AND INTENSITY IN NORMAL AND IRRADIATED RATS BY MEANS OF THE CAPILLARY TUBE METHOD. de Nicola, P.; Scardi, F.; Cipolli, P. L. (Univ., Pavia, Italy). Med. Pharmacol. Exp., 15: 107-15(1966).

Preliminary studies were made of several aspects of the radio-induced blood coagulation disorder in rats given a single 1000 R dose of whole-body x radiation. For the study of the bleeding time in the irradiated rats, after preliminary trials by means of various techniques (tail cut with scissors, a razor blade, with or without ether anesthesia, etc.), a method is presented in which the following steps were followed: ethyl urethane anesthesia, tail cut with a sharp blade, whereby the tail is kept in a 2 mm dia hole in a metal plate, and collection of the blood in capillary glass tubes, according to the technique of de Nicola and Candura. This method made it possible to evaluate also the bleeding intensity, i.e., the amount of blood flowing from the wound during the determination of the bleeding time. Such a technique was applied for the study of normal and irradiated rats, but no results are presented. (BBB)

22735 EFFECT OF INORGANIC COMPOSITION OF THE DIET ON SENSITIVITY TO IONIZING RADIATION AND RADIOMIMETIC SUBSTANCES. Angelico, Raffaele (Istituto Superiore di Sanita, Rome); Manganaro, Mario; Maggiore, Lucia Moretta; Quintiliani, Marcello. Ann. Ist. Super. Sanita, 1: 689-97(1965). (In Italian).

The influence of different quantities of Mn, Mg, Zn, and Cu in the diet on the lethality of either total-body x-irradiated, or nitrogen mustard endoperitoneally injected, rats was studied. Growing male Wistar rats received a purified diet for 75 days. Each group was supplemented with different amounts of the element which was studied. The animals were then either irradiated with 630 R or endoperitoneally injected with nitrogen mustard with doses of 1.2 mg/kg body weight. The irradiated animals were kept on the same diet for 30 days. The nitrogen mustard treated rats were kept for 15 days only. In both cases the lethality, with respect to the rats fed with a basal diet, was registered. The increased amounts of these elements in the diet did not seem to have any influence on the lethality of the irradiated rats. Instead, a protective effect was noticed from these elements in the experiments with nitrogen mustard. Mn caused only an increase in the mean time of survival; Mg and Zn significantly lowered the percentage of lethality at a concentration of 3% $MgCl_2$ and 0.3% ZnO in the diet. The studies indirectly confirm that ionizing radiations and radiomimetic substances, even with the same terminal biological effects, have different mechanisms of action. (auth)

22736 FERTILIZATION AND EARLY DEVELOPMENT AFTER RADIOCOBALT IRRADIATION OF RABBIT OOCYTES AND SPERM IN THE FEMALE TRACT. Chang, M. C.; Hunt, Dorothy M.; Turbyfill, C. L. (Worcester Foundation for Experimental Biology, Shrewsbury, Mass.). Anat. Rec., 154: 713-26(Apr. 1966).

A dose of 400 R was chosen for experiments designed to elucidate the following effects of whole-body x irradiation of rabbits: (1) the fertilizing capacity of sperm when they were in the female tract, (2) on the fertilizability of ova at different stages of maturation and (3) to compare the effect of irradiation in vivo of sperm, of oocytes, or of both sperm and oocytes on their subsequent fertilization and early development. Rabbits were irradiated before

or 4 to 12 hr after mating and an ovulating injection of gonadotropin. The second group was irradiated at about the same time after injection but inseminated after irradiation. The third group was inseminated with sperm irradiated in other females. Ova were recovered at various times for determination of fertilization, cleavage, and blastocyst formation. Animals were autopsied 14 or 29 days later to examine fetal development. The fertilization rate was not disturbed whether sperm, oocytes, or both were irradiated. The disturbance of nuclear material, the aberration of chromosomes, the retardation of cleavage, the fragmentation of cytoplasm, and the failure of blastocyst formation and embryonic development were observed especially whenever oocytes were irradiated. Irradiation of oocytes before mating and injection appeared to be less harmful but no differential effects were observed when irradiation was at 4, 6, 8, 10, or 12 hr after ovulating injection or when oocytes alone or both the oocytes and sperm were irradiated, probably due to the dose being too high. Irradiation of sperm in the female tract was less harmful; normal blastocysts and apparently normal fetuses were obtained when nonirradiated ova were fertilized by such spermatozoa. (BBB)

22737 THE INDUCTION OF ANTIBODY PRODUCTION IN X-IRRADIATED ANIMALS BY MACROPHAGES THAT INTERACTED WITH ANTIGEN. Gallily, Ruth; Feldman, Michael (Weizmann Inst. of Science, Rehovoth, Israel). Israel J. Med. Sci., 2: 358-61(May-June 1966).

Experiments were carried out on the capacity of macrophages from normal, as compared to those from x-irradiated mice, to elicit antibody production in irradiated mice, when injected after an in vitro interaction with Shigella antigen. Macrophages from the peritoneal exudates of normal C57B1 mice were incubated with Shigella, then injected at doses of 15×10^6 cells into mice which had been exposed two days previously to a sublethal dose of 550-R total-body irradiation. The results indicated that macrophages from normal animals after interaction with the antigen elicited the formation of antibody in the irradiated mice, showing a $\log_2$ titer of 4.0 following five days, which had risen to 7.5 when measured after 8 days. The agglutinating titer of the control groups did not rise above 1.6. The macrophages used were contaminated with about 10% lymphocytes. Therefore, the formation of agglutinins to Shigella in the irradiated recipients obtained in the previous experiments could be attributed to the lymphoid components of the peritoneal exudates. To test this, lymphocytes were obtained from the lymph nodes of normal mice and incubated with Shigella. Even doses 7 times greater than those injected together with the macrophage population elicited only a low titer of antibody (less than $\frac{1}{10}$ the titer obtained following the inoculation of macrophages). Therefore, the macrophages rather than the lymphocytes had triggered the formation of antibodies in the irradiated mice. Macrophages cultured in vitro and then interacted with Shigella also elicited the production of agglutinin to the antigen in the irradiated recipients. Macrophages from normal animals elicited antibody production in irradiated recipients, whereas those from irradiated donors did not. It is concluded that x irradiation at sublethal doses impaired the immunological sensitivity of the animal, not only by depleting the lymphoid cell population but, to an even greater extent, by damaging the capacity of the macrophages to process the antigen to an immunogenic state. (BBB)

22738 HISTOLOGICAL INVESTIGATION ON THE EFFECTS OF ^{32}P ADMINISTRATION ON THE ENDOCRINE GLANDS OF PREGNANT MICE. Agawa, Yoshiyuki (Mie Prefectural Univ., Tsu, Japan). Mie Kaibo Gyosekishu, 14: 125-45(1963). (In Japanese).

Pregnant mice were injected subcutaneously with various doses (1 to 20 $\mu C/g$) of ^{32}P on the 8th to 10th day of gestation, and the histology of the endocrine organs of the maternal mice was examined. All endocrine organs examined, including the hypophysis, pineal body, adrenal gland, thymus, submandibular gland, parotid gland, pancreas, thyroid gland, and ovary, showed atrophy of the parenchyma, congestion, and infiltration by round cells. These changes were intensified in parallel with the increase of the dose of ^{32}P which was injected. In the thymus, large mononuclear and polynuclear cells appeared when 8 $\mu C/g$ or more of ^{32}P was injected. Pronounced changes were noted in the submandibular gland, inducing the collapse of cells of the striated portion. The follicular epithelial cells of the thyroid gland generally degenerated, showing frequently holocrine- or apocrine-like secretion, and in some of the surviving cells ciliary formations were observed with the light microscope. Completely degenerated ova were found in the ovary after the injection of 3 $\mu C/g$ or higher doses of ^{32}P that formed a colloidal mass, and numerous blood cells were detected in the follicular cavity. (BBB)

22739 MUTAGENIC EFFECT OF 600-Mev PROTON IRRADIATION. Lamb, M. J.; McSheehy, T. W.; Purdom, C. E. (MRC Radiobiological Research Unit, Harwell, Eng.). Drosophila Inform. Serv., 41: 156(1966).

Experiments, comparing proton irradiations with x irradiation (250 kVp, 15ma, HVL 1.2 mm Cu), were performed as part of a program to investigate the relative effectiveness of different parts of the proton beam which have different LET values. Male Drosophila, 32 hr old, were exposed to 600 rad of protons or x rays at dose rates of 150 rad/min and 540 rad/min respectively. Males were mated individually to 2 females every 3 days, and the frequency of IInd chromosome recessive lethal mutations was scored among offspring from 6 successive broods. A pronounced difference between the percentage of mutations induced by protons and x rays was found in brood IV, but otherwise no significant differences were observed. This may be explained either on the assumption that the irradiated germ cell stages contributing to sperm used in brood IV were much more sensitive to proton than to x irradiation, or that the mutagenic efficiency of protons was slightly greater than that of x rays and a slight shift, or sampling error, during the brood sequence concentrated the effect into a single brood. The second explanation is more plausible, but the results of later experiments suggested that there is no difference between these radiations. When 250-kVp x rays (800 rad) were compared with 600-MeV protons (800 rad) and with attenuated protons in the Bragg peak (400 rad), in only one brood was there any significant deviation from an RBE value of 1 relative to x rays. This was brood II of the 600-MeV proton series, which was significantly low. Overall analysis, however, showed no deviation from 1 and there was no indication, therefore, that the increase in frequency of nuclear interaction in the Bragg peak region was accompanied by any increase in genetic effectiveness. (BBB)

22740 MALIGNANT MESODERMAL MIXED TUMOR OF THE UTERINE CORPUS AFTER IRRADIATION. Garska, Wladyslawa; Zaczek, Tadeusz (Zaklad Anatomii Patologicznej, Szpitala Wojewodzkiego, Rzeszow, Pol.). Ginekol. Pol., 36: 809-14(July 1965). (In Polish).

A case of presumptive radioinduced malignant mesodermal mixed tumor of the uterus is described. The patient was treated 13 years earlier by Ra and x-ray therapy for uterine cervix cancer. The exact doses of radiation used to treat this 62-yr-old patient were not known. Histologic study of the tumor revealed muscle-like cellular elements as well as chondrogenic and osteogenic tissue. A brief review of the literature relating to the etiology of mixed tumors, especially their radiogenesis, is presented. Several previous reports are cited which indicate that irradiation given for malignant uterine neoplasms may act as a causative agent of mixed connective tissue tumors. (BBB)

22741 PERFORMANCE AND IODINE METABOLISM OF DAIRY CATTLE WITH ^{131}I IRRADIATION INJURY. Miller, J. K.; Swanson, E. W. (Univ. of Tennessee, Oak Ridge). J. Dairy Sci., 50: 90-5(Jan. 1967).

Metabolism of dietary iodine, simulated by daily orally administered ^{125}I, was measured before, during, and after exposure to a high ^{131}I level. Four mature cows and 6 growing heifers were given single oral doses of 160 to 220 μCi $^{131}I/kg$ body weight after preliminary measurements of thyroid ^{131}I uptake, thyroid secretion rate, and metabolism of ^{125}I. Radiation doses to the thyroids were calculated as 12,000 to 27,000 rads. Within 10 days, blood plasma ^{125}I concentrations of ^{131}I-treated heifers abruptly rose to 3 times control values, then dropped sharply. The elevated plasma ^{125}I levels, most likely from release by damaged thyroids of previously stored ^{125}I, were accompanied by increased urinary and fecal ^{125}I excretions. Thyroid activity 6 months later was reduced, as shown by average decreases of 64% in plasma protein-bound iodine, 80% in thyroid ^{131}I uptake, and 56% in thyroid secretion rate. Three cows calved 15, 123, and 136 days after each had received 100 mCi of ^{131}I. The 15-day calf was a cretin, with no detectable thyroid activity, the 123-day calf died just after birth, and the 136-day calf was apparently normal. Surviving animals exhibited varying degrees of hypothyroidism 6 months after treatment. Low milk yields of the lactating cows and growth of the cretin calf were improved by feeding iodinated casein. (BBB)

22742 ACUTE RADIATION MORTALITY IN MICE INOCULATED WITH PIGMENTED OR NON-PIGMENTED PSEUDOMONAS. Simmons, M. L.; Franklin, John (Oak Ridge National Lab., Tenn.). Res. Vet. Sci., 8: 71-3(Jan. 1967).

When some species of Pseudomonas are present in mice receiving acute lethal whole-body radiation, very early deaths frequently occur, preventing use of these animals in radiation protection and recovery experiments. Routine bacteriological sampling in an experimental animal unit housing 120,000 animals showed a high incidence of a nonpigmented Pseudomonas, P. stutzeri. To

determine whether P. stutzeri was involved in the early-death syndrome in x-irradiated mice, the pathogenicity of P. aeruginosa for mice was compared with that of P. stutzeri, on the basis of time of death and subsequent recovery of the microorganisms for animals dying after irradiation. Different groups of lethally irradiated (950 R) and normal control (C3BFI) mice were inoculated with the pigmented P. aeruginosa or with P. stutzeri by intraperitoneal and oral routes. Thirty-two of 50 mice receiving P. aeruginosa died within 8 days after irradiation, and 29 of the 32 showed pigmented P. aeruginosa on heart blood culture. Fewer early deaths were seen with oral administration of the organisms than with intraperitoneal administration. Two out of 50 mice given P. stutzeri died within 8 days of exposure to x rays. Neither showed the organism on heart blood culture. No pigment reversion for either organism was demonstrated in vivo. Thus P. stutzeri is not involved in the early-death syndrome in x-irradiated mice. (BBB)

22743 ACTION OF THE NATURAL RADIOMIMETICS, IONIZING RADIATION, AND VIBRATION ON A CHANGE IN HISTAMINE LEVEL IN RAT TISSUES. Bilushi, S. G.; Goncharenko, E. N.; Kudryashov, Yu. B. Nauch. Dokl. Vyssh. Shkoly, Biol. Nauk., No. 1, 87-9(1966). (In Russian).

The effects of natural radiomimetics, single whole-body x radiation doses, and vibration on the content of biologically active free histamine in the kidney, liver, skin, and stomach of rats were investigated. The natural radiomimetic was obtained from the liver of 1000-rads γ-irradiated rabbits 3 days postirradiation by means of lipid extraction with ethanol and precipitation of phospholipids with acetone; doses of 0.7 to 1.0 g/rat were administered intraperitoneally. Rats were subjected to vibration (70 hertz frequency, 0.5 to 6 mm amplitude) for 1 hr. Rats in the radiation group received 800-rads whole-body x radiation. All animals in each group were sacrificed at 1 or 3 hrs following administration of the radiomimetic, 5 min or 3 days postirradiation, and 5 min, 1 hr, or 3 days after the vibration treatment. The content of biologically active free histamine in the organs was determined by chromatography. The free histamine content in all of the organs investigated 5 min after the vibration treatment was significantly increased and after 1 hr it returned to normal and remained stable. The content of histamine in the kidneys of the radiomimetic and x-irradiated rats 3 days posttreatment was 3.5 μg and 6.2 μg respectively; in the liver 6.3 μg and 10.1 μg, respectively. At 1 hr after administration of the radiomimetic preparation, the content of histamine in the liver was 9.0 μg; at 5 min after x-irradiation, 6.3 μg. No significant differences were found in the values obtained for histamine content of the skin. (TSS)

22744 STEREOTAXIC METHOD OF HYPOPHYSECTOMY AND THE EFFECTS OF BETA-IRRADIATION OF THE PITUITARY GLAND IN SEXUALLY IMMATURE MALE SWINE. Roesel, Oscar Frederick. Lafayette, Ind., Purdue Univ., 1966. 89p. Thesis.

Of the 85 sexually immature swine used in this study, six were used for the preparation of an atlas, in situ destruction of hypophyseal tissue was produced in 49 pigs for the development of technique, and 30 were used to determine the effects of beta-irradiation induced hypopituitarism. A needle or an electrode was stereotaxically placed into the pituitary gland. Three basic needle paths through the brain were tried. In the most advantageous approach, the needle was inserted on the dorsal midline through a trephine opening between the lateral canthi of the eyes. No deleterious effects were noted as a result of the passage of the needle through the brain. Electrolysis, chemicals, mechanical destruction, and beta-irradiation were employed as means of destroying the pituitary. Only beta-irradiation was found to be practical. Fifty mCi of Sr-90 sealed in the tip of a 19-gauge needle was used as the radiation source. The group of 30 animals (Yorkshire–Chester White males between 15 and 30 weeks of age) consisted of four normal controls, four sham operated controls, and 22 beta-irradiated animals. The pituitary glands of the irradiated animals were exposed to beta-irradiation for periods ranging from 13 to 34 minutes. At the time of necropsy, 15 to 20 weeks after irradiation, the extent of destruction of anterior pituitary tissue was found to be from 60 to 96 percent. The classical signs of hypopituitarism were evident in those animals in which 80 percent or more of the anterior pituitary had been destroyed. The growth rate (bone growth and weight gain) was decreased roughly in proportion to the amount of anterior pituitary destroyed. The rate of bone growth was decreased in all of the irradiated animals. However, rate of weight gain was not impaired until destruction was 70 to 75 percent. Differences in the weights of adrenals and thyroid glands were not consistent, but the follicular epithelium of the thyroids of pigs with 80 percent or more of the anterior pituitary destroyed was of a low cuboidal type. These animals were lethargic. Atrophy of testes was more extensive in animals whose stalk and dorsal pituitary was destroyed than it was in those that had less destruction of this area. Testicular atrophy was first detected two weeks after irradiation and resulted in extensive involution of sex accessories. Retention of juvenile hair coat, ascites, hydrothorax, and hydropericardium were evident in the animals with 80 percent or more of the anterior pituitary destroyed. These animals also had a marked stiffness of gait when first forced to move. This stiffness was not due to arthritis since no joint abnormalities were evident grossly or radiographically. In general, the effects of partial ablation of the hypophysis of swine were similar to those reported in other species. (Dissertation Abstr.)

22745 IMMUNITY TO FASCIOLA HEPATICA INFECTION IN ALBINO RATS VACCINATED WITH IRRADIATED METACERCARIAE. Thorpe, E.; Broome, A. W. J. (Imperial Chemical Industries Ltd., Macclesfield, Eng.). Vet. Rec., 74: 755-6(June 30, 1962).

The effect of various levels of irradiation of the metacercariae of F. hepatica on their subsequent maturation in the albino rat was investigated. The level of immunity to a subsequent challenge infection by immunization with metacercariae attenuated by irradiation was also studied. Rats were given an oral vaccinating dose of 40 metacercariae irradiated at 1000, 2500, 5000, 7500, and 10,000 R respectively. Seven weeks after this oral vaccination 10 rats from each group were challenged with 20 nonirradiated metacercariae. Eleven weeks after the vaccination a further 10 rats from each group were challenged with 20 nonirradiated metacercariae and a group of 10 nonvaccinated rats received 20 metacercariae as a control to the challenge. Ten weeks after the challenge infections the rats were killed, i.e., 17 and 21 weeks from the outset. The effect of various levels of x irradiation on the ability of the metacercariae of F. hepatica to reach maturity in the albino rat is shown. At the 1000-R level the 4 survivors had patent infections with an average of 6.8 flukes per rat, and considerable scarring of the liver. Exposure of 2500 R caused a marked reduction in the number of flukes reaching maturity, with an average of 0.5 per rat. No rats in this group died and only an occasional focal scar in the liver was found at autopsy. At 5000 R only 1 fluke was recovered and macroscopic liver damage was absent. No flukes and no lesions were recorded for the 7500- and 10,000-R groups. Other experiments were concerned with successful maturation of the challenge infections of 20 metacercariae in the rats vaccinated 7 and 11 weeks previously. Following oral vaccination with metacercariae irradiated at 1000 R there was evidence of immunity to challenge, and at a level of 2500 R there was significant immunity. The animals that received vaccinating doses, exposed to 5000 and 7500 R, and challenged at 7 weeks, had no detectable immunity. However, in the animals challenged at 11 weeks a significant immunity was present in the 5000- and 7500-R groups and minimal liver damage was noted. At neither time of challenge did the administration of cercariae irradiated at 10,000 R give rise to any significant degree of immunity and the liver lesions were severe. (BBB)

22746 EFFECTS OF HEAVY X IRRADIATION OF THE SPLEEN ON THE SURVIVAL OF MICE. Sakka, Masatoshi; Sakamoto, Kiyohiko (Tokyo Medical and Dental Univ.). Nippon Igaku Hoshasen Gakkai Zasshi, 23: 838-40(Oct. 25, 1963).

Doses up to 12,000 R to the surgically exteriorized spleen of dd strain mice did not produce acute hematologic death. After 2000 R to the spleen all animals survived and no sign of systemic injury was observed. Also, following 10,000 R to the spleen, all animals survived, and the rate of increase in body weight was identical in treated and control groups. There was no significant difference in weight of spleens in the 2 groups but the organ was tightly encapsulated by the peritoneum in x-ray-treated animals. After 12,000 R to the spleen, 20 out of 21 animals survived; 1 mouse died on the third day due to surgical procedures. The irradiated spleen was reduced in size; the mean weight of the spleen 3 days after irradiation with 12,000 R was 60.8 mg for a mean body weight of 22.8 g. It was considerably below the control value of 116 mg for a mean body weight of 23.9 g. Spleens regained weight gradually during the month after irradiation, weighing 89.0 mg for body weight of 27.8 by the 30th day. Since it was not possible to measure directly the weight of the spleen before and after irradiation in the same animal, the product of the long and short axis of a spleen was compared immediately before and one month after irradiation. From the respective values, 82 and 50 mm, it was concluded that the recovery of the spleen was not complete by the first one month after irradiation. (BBB)

22747 LATE EFFECTS OF LOW-DOSE WHOLE BODY X-IRRADIATION OF FOUR-DAY-OLD RATS. Billings, Marta S.; Yamazaki, James N.; Bennett, Leslie R.; Lamson, Baldwin G. (Univ. of California, Los Angeles). Contract AT(04-1)-Gen-12. Pediatrics, 38: 1047-56(Dec. 1966). (UCLA-12-583).

Four-day-old male and female Long–Evans x Sprague–Dawley F_1 hybrid rats were exposed to a single total body x-ray dose of

125, 25, 5, and 0 R and then were observed during their entire life-span for weight changes, signs of morbidity, and age at death. There was a 10% reduction of life span in the 125 R exposed female rats. None of the male groups showed significant shortening of longevity. Mean body weights were consistently lower in both male and female groups exposed to 125 R total body irradiation. Female rats exposed to 25 and 125 R attained their maximum weights at a younger age than their non-irradiated controls. External tumors appeared earlier in female rats. Tumor incidence was not increased by irradiation in either sex. Male parentage influenced the length of life span of progeny to a greater degree than the irradiation exposure at the employed dose-level. The influence of female parentage upon longevity cannot be evaluated in this study. Low dose radiation life shortening can only be demonstrated in long-lived strains. Hereditary and radiation life shortening effects are not cumulative under conditions of this study. (auth)

22748 RADIATION CHIMERAS AND GENETICS OF SOMATIC CELLS. Lengerova, Alena (Inst. of Experimental Biology and Genetics, Prague). Science, 155: 529-35(Feb. 3, 1967).

A theoretical discussion is given on radiation chimeras as model systems for research in the selection and detection of genetic variants in somatic cells. Principles and systems for detection of heterozygous somatic cell hybrids and homozygous cell variants (due to mitotic crossing-over) based on graft-to-graft interactions are presented. Methods for selection of cell variants due both to mitotic crossing-over and to somatic mating followed by segregation are outlined. Illustrations of these systems are provided in the text. (30 references). (B.H.S.)

22749 EFFECT OF THE CONTINUOUS IRRADIATION OF BONE MARROW ON THE COLONY-FORMING ACTIVITY AND DIFFERENTIATION OF THE STEM CELLS. Juraskova, Vera (Inst. of Biophysics, Brno). Folia Biol. (Prague), 13: 79-83(1967).

The decrease in the number of the hematopoietic stem cells in the bone marrow of C57BL mice irradiated continuously with gamma rays (^{60}Co) has been ascertained at an exposure rate of 1 R/hr. The diminution of the number of the stem cells has been studied by the method of the colonies of hematopoietic tissue in the spleens of irradiated recipients given continuously irradiated bone marrow. After a ten-day exposure of the donors the number of the stem cells in their bone marrow decreased to 30 to 40% as compared with non-irradiated controls. A certain steady state then set in, and the number of the stem cells remained constant, except for small fluctuations, up to 160 days of continuous irradiation. The colonies of the hematopoietic tissue were examined histologically, and their character was determined. No significant differences in the ratio of erythroid to myeloid colonies were found. Hence it followed that the pluripotency of the hematopoietic stem cells and their tendency to form mostly the erythroid colonies is not affected by continuous irradiation lasting as long as 160 days. (auth)

22750 HYGIENIC ASSESSMENT OF THE MAXIMUM PERMISSIBLE CONCENTRATION OF ULTRAVIOLET RADIATIONS IN THE ARTIFICIAL LIGHTING. Mokhov, Yu. I. Gig. Sanit., No. 12, 10-14(Dec, 1966). (In Russian).

Rabbits' eyes were subjected to long-wave ultraviolet irradiation (3/4 erythema dose a day). In the first group this dose was given in 30 min at an intensity of 95 $\mu W/cm^2$, in the 2nd group in 1 hr 30 min at −31.6 $\mu W/cm^2$, in the 3rd in 3 hr at −15.5 $\mu W/cm^2$, 4th in 5 hr at −9.5 $\mu W/cm^2$. The irradiation was continued for 4 months; during this period the animals received 70 erythema doses. No visible clinical symptoms could be detected in the rabbits except in those of the first group, that were irradiated by a dose 15 times higher than the normal one. (auth)

22751 RESPONSE OF MICE OF DIFFERENT STRAINS FROM THE VIEWPOINT OF THE APPEARANCE OF LEUKEMIA INDUCED BY THE ADMINISTRATION OF URETHAN AND X RAYS. Chouroulinkov, I.; Riviere, M. R.; Arnold, J.; Guerin, M. (Institut de Recherches Scientifiques sur le Cancer, Villejuif, France). Compt. Rend. Soc. Biol., 160: 1369-73(1966). (In French).

The sensitivity of mice of five different strains was investigated from the viewpoint of the appearance of leukemia produced within six months following the administration of urethan or of whole-body x irradiation, employed alone or together. There were different characteristics in the responses according to the strain of mouse. The most significant results were observed in the IC and AKR mice. The study of the combined effects of irradiation and urethan showed that there is no inhibiting effect and that the x ray seems to act independently of the urethan. (tr-auth)

22752 EFFECTS OF X-IRRADIATION ON POSTEMBRYONIC DEVELOPMENT OF SARCOPHAGA PEREGRINA ROBINEAU-DESVOIDY. I. Sasaki, S. (Tohoku Univ., Sendai). Dobutsugaku Zasshi, 75: 207-14(July 15, 1966). (In Japanese).

When larvae were x irradiated with 0.5 to 50 kR, they were not killed and developed to prepupae. Irradiation of larval and prepupal stages caused death in the early pupal stage (early death); disturbance in exchange of the hypodermis was observed. When pupae were irradiated at 20 hr of age or later, development continued but emergence did not occur because of general suppression of differentiation (late death). Radiosensitivity, when determined by the emergence rate, was scarcely altered during the period from second instar larva to second day pupa and thereafter it dropped off gradually. The most radiosensitive stage was 30 to 50 hr-old pupae; fully grown 7th day pupae were about 56 times as radioresistant as that of first day pupa. The change in DNA synthesis rate was correlated with the change in radiosensitivity of the pupal stages except for the late pupal stage. Results of partial body irradiation of first day pupa were also reported. Irradiation of the head and thorax had an equivalent effect to whole-body irradiation; irradiation of the head had the greatest effect. (TSS)

22753 EFFECT OF FRACTIONATED X-RAYS AND γ-RAYS IRRADIATION ON TADPOLE OF AMPHIBIA. I. RANA NIGROMACULATA. Tanaka, Norimoto (Kyoto Prefecture Univ. of Medicine). Nippon Igaku Hoshasen Gakkai Zasshi, 26: 910-13 (Oct. 1966). (In Japanese).

The effect of fractionated x ray and γ ray radiation doses on the survival of Rana nigromaculata tadpoles was studied. Frog eggs from a rice field were collected and allowed to hatch; 25 mm tadpoles from the same egg block were used. Radiation was delivered at 80 kVp, 4 mA, no filtration; dose rate was ~300 R/min at a 10 cm focus−animal distance. Experimental methods were as follows: 1200 R; 600 R 12 hr 600 R; 600 R 24 hr 600 R; 400 R 12 hr 400 R 12 hr 400 R; and 400 R 24 hr 400 R 24 hr 400 R. Figures illustrating typical survival curves for single radiation doses or fractionated radiation doses are presented. The recovery phenomenon that has been observed in mammals was not found in this study; survival response showed a significant difference when the fractionated radiation dose groups were compared to single dose radiation groups. It was concluded that the radiosensitivity of tadpoles to fractionated radiation doses was probably dependent on the time interval rather than fractionation of the dose. (NSA of Japan)

22754 ELECTROMYOGRAPHIC STUDY ON THE EFFECTS OF RADIATION APPLIED TO THE SPINAL CORD. Kuroda, Yasumasa (Kobe Medical Coll., Japan). Nippon Igaku Hoshasen Gakkai Zasshi, 26: 927-36(Oct. 1966).

A review of the literature on sensitivity of neural tissues, especially the spinal cord, to ionizing radiations and a discussion on the clinical applicability of electromyography for examination of radioinduced myelopathy is presented. (TSS)

22755 RELATIVE BIOLOGICAL EFFICIENCY OF FAST NEUTRONS AND γ RAYS ON LOACH SPERM AND DNA OF IRRADIATED SPERM. Shekhtman, Ya. L.; Breiksh, I.; Struchkov, V. A. (Inst. of Biological Physics, Moscow). Radiobiologiya, 6: 495-9 (1966). (In Russian).

The relative biological efficiency of fast neutrons is determined by two criteria: (a) survival of the embryos from roe impregnated with irradiated sperm (RBE = 1.9) and (b) measurement of the bond strength of DNA separated from irradiated sperm by the phenol method (RBE = 2.45). The analysis of the dose curves for γ rays and fast neutrons made it possible to calculate by the target theory the parameters of the natural DNA molecule in the head of the loach sperm: $M \sim 2.8 \times 10^8$; the transverse dimensions of the molecule are approximately 18.4 Å and the length of the molecule is approximately 136 mk. The length of the individual fibrils of the natural DNA was determined by the electron microscopic method from the head of the loach sperm to be 18 mk. (tr-auth)

22756 CHANGES IN PERIPHERAL BLOOD PICTURE OF MICE DURING CHRONIC ^{90}Sr INFLUENCE. Panchenko, I. Ya. Radiobiologiya, 6: 623-4(1966). (In Russian).

During chronic introduction of ^{90}Sr in mice at concentrations of 3.5×10^{-10}, 3.5×10^{-9}, 3.5×10^{-8}, and 3.5×10^{-7} Ci/mouse, persistent decrease of the hemopoiesis and of the comparative and absolute lymphocytopenia was observed up to six months after the beginning of the tests in animals of the fourth group. Analogous blood changes were observed in animals of the third group at the end of the test. After introduction of ^{90}Sr the sharpest changes of the blood system were observed in mice of the BAlb and $CC_{78}Br$ lines and the least change was observed in mice of the $C_{57}Bl$ line and the most stable in mice of line A. (tr-auth)

22757 INFLUENCE OF RADIOISOTOPES ON IMMUNOLOGICAL REACTIONS IN ANIMALS. Yakim, S. M. Radiobiologiya, 6: 627-9(1966). (In Russian).

During subcutaneous introduction of ^{60}Co and ^{131}I simultaneously with the second immunization, phagocyte activity of the leukocytes and formation of agglutinins were depressed. The agglutinin formation process in the blood and the increase of the phagocyte index of the leukocytes in rabbits, exposed to immunization within one month after the introduction of the radioactive isotopes, occured significantly faster than in animals in which the isotope was introduced simultaneously with the immunization. (tr-auth)

22758 TREATMENT OF HEREDITARY SPHEROCYTOSIS IN PEROMYSCUS BY RADIATION AND ALLOGENEIC BONE MARROW TRANSPLANTATION. Steinmuller, David; Motulsky, Arno G. (Univ. of Washington, Seattle). Blood, 29: 320-30 (Mar. 1967).

An inherited disease of the bone marrow identical in its pathophysiology to human hereditary spherocytosis has been described in the deer mouse, Peromyscus maniculatus. As Peromyscus are not inbred and of distinct individually-specific histocompatibility, they provide an experimental model system for the use of hemopoietic allotransplantation in the treatment of hereditary diseases of the erythron. Ninety adult mice were exposed to otherwise 100 per cent lethal doses of x-rays and then inoculated intravenously with 20 to 60 million nucleated marrow cells. Marrow was transplanted on a one-to-one donor recipient basis in four combinations of phenotypes: normal to normal; spherocytic to normal; spherocytic to spherocytic; and normal to spherocytic. Mortality and pathology were similar in all groups. Thirty per cent of the hosts died as a direct result of the irradiation within 20 days. Another 30 per cent subsequently succumbed to secondary disease presumably of graft-against-host origin, bringing the overall mortality to 60 per cent at the end of 10 weeks. At 3 months, however, the hematologic status of the survivors, nearly without exception, was of donor phenotype: Genetically spherocytic recipients of normal marrow contained normal red cells; conversely, wild type recipients of spherocytic marrow had assumed the mutant phenotype. Evidence of chronic grafthost interaction was obtained. By 7 months, six mice in the spherocytic to normal transplant group had reassumed the host hematologic phenotype, but only one animal in the normal to spherocytic group reverted to the mutant phenotype. (auth)

22759 ASSOCIATION OF ILLNESS WITH PRIOR INGESTION OF NOVEL FOODS. Revusky, S. H.; Bedarf, E. W. (Army Medical Research Lab., Fort Knox, Ky.). Science, 155: 219-20 (Jan. 13, 1967).

Rats were permitted to ingest a novel food and a familiar food. One hour later they were x-irradiated. When they were subsequently allowed to choose between these foods, their preference for the novel food was less than that exhibited by appropriate controls. (auth)

22760 LASER EFFECTS ON SOME PHYTOPHAGOUS ARTHROPODS AND THEIR HOSTS. Wilde, W. H. A. (Univ. of Guelph, Ontario). Ann. Entomol. Soc. Amer., 60: 204-7 (Jan. 1967).

Low-energy ruby laser pulses of 0.6 J/msec^2 produced degrees of damage relative to the colored pigmentation of certain arthropods and their plant hosts; the darker the pigmentation, the more severe the damage. Structural shape and microdistance between arthropod life stages and host surfaces were other factors affecting the degree of laser damage. Rounded surfaces reflected laser pulses more than did elliptical or flat surfaces, even when coloration was similar. Microdistances appeared to serve as insulation against residual or reflected heat from lasered host-plant areas. Two species of mites, Panonychus ulmi and Tetranychus urticae; the greenhouse whitefly, Trialeurodes vaporariorum; the green peach aphid, Myzus persicae; and the pear psylla, Psylla pyricola, were used as test arthropods. The host plants were pear seedlings, alfalfa, and rye grass (Bromus sp.). (BBB)

22761 IONIZING RADIATION INFLUENCE ON MORPHOGENESIS OF SKIN STRUCTURES IN CULTURES PREPARED ACCORDING TO LAZARENKO. Khlystova, Z. S.; Rakitina, O. N. (Orenburg Medical Inst., USSR). Radiobiologiya, 6: 574-7(1966). (In Russian).

By whole-body irradiation of the recipient, the regeneration capacity of implanted skin tissue of healthy donors was reduced. The reduction of the regeneration property of the skin tissue of donors occurs in rigid conformity with the degree of radiation damage of the recipient organism. By local irradiation and also whole body irradiation of the donor at lethal doses, the viability of the skin tissue was preserved. During implantation of healthy recipients they show natural hystoblastic and organoblastic properties. (tr-auth)

22762 REGULARITIES OF POST-IRRADIATIVE DEATH OF DIFFERENTIATING NERVOUS CELLS. I. INVESTIGATIONS OF HEN EMBRYO. Korogodina, Yu. V. (Inst. of Medical Radiology, Obninsk, USSR). Radiobiologiya, 6: 560-4(1966). (In Russian).

The irradiation of chicken embryos incubated 3 to 3.5 days in vivo with ^{60}Co γ rays at doses of 1200 R causes massive death of the nerve cells of the brain partitions. The cells affected are participating in active formation processes unconnected with pathological cellular fission (interphase death). For development of the primary radiation damage, causing interphase cellular death, conditions guaranteeing their specialized functioning are necessary. (tr-auth)

22763 INFLUENCE OF X RAYS ON THE NORMAL AND REGENERATING EPITHELIUM OF MOUSE CORNEA. Studitskii, A. N.; Popova, M. F.; Bulyakova, N. V. (Inst. of Animal Morphology, Moscow). Radiobiologiya, 6: 544-8(1966). (In Russian).

The effect of x ray on normal and regenerating epithelial cornea was investigated in mice. Under light nembutal narcosis there was complete removal of the cornea epithelia. Within three days the mice were exposed to x ray doses of 700 R. The mitotic index and the chromosome aberrations in the cells in the normal and regenerated epithelium were used as measurement of the x ray effect. The results are graphed. The results indicated that irradiation caused less damaging effects on the regenerating epithelium than on normal unregenerating tissue. The reasons for the greater radiostability of the regenerating cells are discussed. (J.S.R.)

22764 EXPERIMENTAL DEMONSTRATION OF THE EFFECTS OF SMALL DOSES BY COMBINATION IRRADIATIONS. Meyer, R. D.; Trautmann, J. (Staedtische Krankenhaus, Berlin-Moabit, Ger.). Radiol. Austr., 13: 15-28(1962). (In German).

Rats, rabbits, and mice were irradiated with several combinations of x radiation doses. The doses administered ranged from 300 to 3000 R given in a single whole-body exposure, or as single whole-body doses of $\frac{1}{4}$ R given daily for up to 100 days. Some animals were given combinations of the fractionated and the single whole-body irradiations after infection with Klebsiella pneumoniae. The effects of preirradiation with small daily doses on survival and other biological parameters, including blood and bone marrow changes and morphology of rat testes, are reported. (TSS)

22765 EXPERIMENTAL STUDIES OF THE KIMMIG LIGHT BAND. Burckhardt, W.; Huber, H. R. (Staedtische Poliklinik fuer Haut-Krankheiten, Zurich). Dermatologica, 133: 58-62 (1966). (In German).

The absorption band between 480 and 520 mμ characteristic of a colored material obtained from urine of patients with light dermatoses, following ether extraction and HCl acidification, is called the Kimmig light band. This chromogen has been identified as an indole derivative, N-(β-[indolyl-$_3$-acryl]-glycine). Frequently it is found in light dermatoses only after exposure to sunlight and with light erythema. This study showed that Kimmig's band is seen not only in the polymorphic photodermatoses, but also in all cases of solar burns. It was found in 30 out of 51 cases that included polymorphic photodermatoses, light eczema, spring light dermatoses, phototoxic light exanthema, cheilitis solaris, and porphyria tarda. In 10 persons tested, it was found in urine when uv erythema was produced by exposure of from 2 to 12 dm^2 of skin surface. When triamcinolone was given in 4-mg doses thrice daily for 3 days, the erythema and color band development was delayed and attenuated. The color band was also produced 10 to 20 hr after a 10% β-naphthol salve was spread onto a skin surface of 1 or 2 dm^2 in 10 test patients treated for acne. This salve produces a pronounced erythema. The color band disappeared from the urine of these patients within a week. Out of 148 patients with various types of dermatoses, lupus erythermatosus, solar erythema, uv erythema, burns, and psoriasis vulgaris, 94 were positive for the light band. From these results it appeared to be a nonspecific response to skin inflammations, accompanied by protein breakdown. (BBB)

22766 POSTNATAL IMMUNOLOGICAL CHANGES IN RATS EXPOSED TO THE INFLUENCE OF COMPARATIVELY SMALL DOSES OF IONIZING RADIATION AT THE 16th TO THE 20th DAY OF EMBRYOGENY. Pel'ts, D. G. (Ufa Scientific-Research Inst. of Hygiene and Occupational Diseases, USSR). Radiobiologiya, 6: 565-7(1966). (In Russian).

The effects of ionizing radiation administered five days in a row at 4.65 R/day between the 16th and 20th day of embryogenesis depresses the phagocyte activity of the leukocytes in the irradiated animals in the first month of postnatal development and the production of agglutinin in the postnatal period. (tr-auth)

22767 HISTOCHEMICAL MUTABILITY OF NUCLEOPROTEID IN THE SUPRARENAL MEDULLARY CELLS FOLLOWING γ IRRADIATION. Shabadash, A. L.; Rostomyan, M. A. (Inst. of Biochemistry, Erevan). Biol. Zh. Arm., 19: No. 8, 12-19(Aug. 1966). (In Russian).

Cytochemical studies of nucleoproteids in chromaffinic and

intramural nerve cells of suprarinal medulla in grown rats exposed to single 1000 R γ irradiation revealed first reversible and then irreversible processes. The ribonucleoproteids (RNP) of the intramural nerve cell mitochondria were the first to respond to the irradiation followed within 10 min by the RNP of chromaffinic cell mitochondria. The medulla of chromaffinic cells to the physiological irritation (false radiation) and to the ionizing irradiation during the first five minutes reacts in different ways; in the first case the isoelectric points in RNP granular structure shift toward acid side while after ionizing irradiation the shift is to the alkali side. The two processes lead to a false normalization which is followed by considerable secondary shift to the acidity phase. Generally, radiobiological reactions are inherent to all suprarenal medulla cells; however, the intensity, the direction of the processes and response, are different and unique for each type. (R.V.J.)

22768 EFFECTS OF GAMMA RADIATION AND HORMONES ON NEUROSECRETORY CELL FUNCTION. Voitkevich, A. A. (Inst. of Medical Radiology, Obninsk, USSR). Probl. Endokrinol. Gormonoterap., 12: No. 6, 86-90(Nov.-Dec. 1966). (In Russian).

Hypothalamic extracts tested were obtained from rats of the Wistar strain, given thyroidin or hypertonic sodium chloride, or subjected to gamma-irradiation (700 R). Some of the material was treated histologically for detection of microstructural and histochemical changes in the supraoptic and paraventricular nuclei. Rats, subjected to electrocoagulation of the distal portion of hypothalamo-hypophyseal tract (atrophy of the adrenal gland and thyroid gland, reduction of basophils in the adenohypophysis) served as a test object. The extract efficacy was in direct relationship to the amount of Gomori-positive substance deposited in the neurons (thyroidin). Stimulation of neurosecretory cells (sodium chloride) failed to be accompanied by a complete loss of the capacity to activation of hypophysis and of the peripheral glands. Irradiation failed to introduce any new qualitative specificity into the functional changes of neurosecretory cells. (auth)

22769 EFFECTS OF UV RAYS ON THE MATURING AND SURVIVAL OF ASKARID AND WHIPWORM. Bizyulyavichyus, S. K. (Inst. of Zoology and Parasitology, Vilynus, USSR). Lietuvos TSR Mokslu Akad. Darbai Ser. B, No. 1, 63-75(1966). (In Russian).

Data on the uv ray effects (from a PRK-2 tube) on the maturation and viability of ascarid (Ascaris lumbricoides) and whipworm (Trichocephalus trichiurus) eggs at various stages of development showed that small doses (up to 40 mer $\cdot h/m^2$) do not affect the viability of the helminth eggs. As a matter of fact the UV rays contributed to a more rapid egg maturation of eggs found in moist media. Exposure to 240 mer $\cdot h/m^2$ doses completely destroyed the viability of ascarid and whipworm eggs at various stages of maturation. The results showed that inhibiting effects of uv rays depend on the dose, stage of egg maturation, and the condition of the medium through which the ray is penetrating. (R.V.J.)

22770 REDUCED NICOTINAMIDE ADENINE DINUCLEOTIDE PHOSPHATE IN THE LIVER OF X-RAY IRRADIATED RATS. Hilgertova, J.; Sonka, J.; Dienstbier, Z. (Charles Univ., Prague). J. Nucl. Biol. Med., 10: 72-5(Apr.-June 1966).

The concentration of NAD^+, $NADP^+$, NADH, and NADPH was estimated in rat liver up to five days following x irradiation (dose 800 R). A pronounced depression of the NADPH level was observed immediately after irradiation with a steady tendency to decrease. The concentration of NAD^+ remained stable during the first few days and a drop came as late as the third day after exposure. The levels of two other pyridine nucleotides ($NADP^+$ and NADH) show only a moderate decrease. The lowered concentration of NADPH after irradiation is discussed in connection with possible processes leading to its damage. (auth)

22771 FUNDAMENTAL NUCLEAR ENERGY RESEARCH, 1966. A Supplemental Report to the Annual Report of Congress for 1966. Washington, D. C., Atomic Energy Commission, 1966. 385p. GPO $2.50.

The most noteworthy recent developments in AEC-sponsored research are summarized. Basic, applied, and exploratory research is reported in the fields of biology and medicine, basic physics, and reactor technology. Separate abstracts were prepared for each of the three major divisions of the report. (H.G.D.)

For abstracts of individual sections see: 21938, 22772, and 23659.

22772 BIOLOGICAL, MEDICAL, AND ENVIRONMENTAL RESEARCH PROGRAMS. pp 1-109 of Fundamental Nuclear Energy Research, 1966. Washington, D. C., Atomic Energy Commission, 1966.

Research on late somatic effects of radiation, space radiation biology, photobiology, radiation genetics, radioprotective agents, molecular biology, environmental radioactivity, atmospheric radioactivity and fallout, and cancer research is summarized. (H.G.D.)

Radiation Effects on Plants

Refer also to abstracts 22233, 22279, 22280, 22387, 22388, 22595, 22653, and 22760.

22773 (IAEA-2466-14) INVESTIGATIONS ON MUTABILITY OF POLYGENES AND ON UTILIZATION OF INDUCED GENETIC VARIABILITY. Final Report. Scossiroli, R. E. (Pavia Univ. (Italy). Istituto di Genetica). Sept. 30, 1966. IAEA Contract 61/US; AT(30-1)-2466. 149p. Dep. mn. CFSTI $3.00 cy, $0.65 mn.

Results are summarized from a series of studies on the effects of the treatment of seeds with various doses of x radiation on the induction of mutations with quantitative traits that affect the agricultural value of the plants. Data are included from extensive studies on maize (Zea mays) and on three varieties of wheat, Triticum monococcum, Triticum durum, and Triticum aestivum vulgare. Zea mays is a cross-fertilizing species with diploid chromosome set, T. monococcum is a self-fertilizing diploid species, T. durum is a self-fertilizing tetraploid species, and T. aestivum vulgare is a self-fertilizing hexaploid species. Radiation doses used ranged from 500 to 8000 R. Procedures used for genetic analysis and handling the experimental materials in the laboratory and in the field over a number of generations are described. The effects of exposure of pollen to various doses of x radiation on the induction of genetic changes were also investigated. Preliminary studies on the effects of seed irradiation on variability for quantitative traits in alfalfa, tobacco, and tomatoes are reported. A list is included of 34 publications that describe various aspects of the study. (C.H.)

22774 (NP-16636) RADIOSENSITIVITY AND NUCLEAR VOLUME IN THE GYMNOSPERMS. Final Report. Conger, Alan D.; Cromroy, Harvey (Florida Univ., Gainesville). June 1966. Contract OCD-PS-64-69. 36p.

The sensitivities to acute cobalt-60 gamma radiation of five species of gymnosperms were studied. The species were Pinus elliotti, Pinus palustris, Juniperus conferta, Podocarpus macrophylla and Zamia floridana. The nuclear and interphase chromosome volumes (nuclear volume divided by chromosome number) were calculated from measurements of shoot meristematic nuclei for each species. The plants, which were 1- to 2-year seedlings or 1-year old rooted cuttings, received acute radiation, taking care to shield the roots and thus simulate irradiation under natural growing conditions. The gymnosperms are a very radiosensitive group of plants; the 50 percent lethal doses (LD_{50}) for the species studied ranged from 500 to 760 R. The correlation between radiosensitivity and nuclear (or interphase chromosome) volume for the species studied agreed quite well with values obtained from other acutely irradiated woody species. For an untested species, determination of interphase chromosome volume will permit fairly accurate prediction of the LD_{50} dose to be expected. (auth)

22775 (ORO-3400-2) [CHARACTERISTICS OF XYLEM TISSUES EXPOSED TO IONIZING RADIATION. (1) A STUDY OF CAMBIAL DERIVATIVES IN YOUNG WOODY STEMS SUBSEQUENT TO GAMMA IRRADIATION. (2) AN ANALYSIS OF THE INTERNODAL DISTRIBUTION OF THE ANATOMICAL AND MECHANICAL EFFECTS OF IN VIVO IRRADIATION]. Progress Report, May 1, 1966-April 30, 1967. Hamilton, J. R. (West Virginia Univ., Morgantown. Div. of Forestry). Contract AT(40-1)-3400. 12p. Dep. mn. CFSTI $3.00 cy, $0.65 mn.

Loblolly pines (Pinus taeda) were exposed to gamma radiation and effects on xylem tissues were studied. It was noted that the severity of xylem aberrations was correlated with irradiation treatments. Three groups of pine seedlings were exposed to gamma radiation for one year. In the first group all of the aboveground parts of the plant were irradiated. In the second group the lower 6 inches of the stems were shielded. In the third group the upper 6 inches of the stems were shielded. It was found that microscopic changes in the cells were related to the treatment. Severe abnormalities occurred only in the unshielded portions. Height growth was severely restricted in the first two groups. A second project was designed to study the effects of acute whole plant irradiation. The tensile strength of wood was reduced by irradiation. Irradiated latewood cells were thinner walled and larger in diameter than the controls. (H.L.W.)

22776 RESPONSE OF PINES IRRADIATED WITH LETHAL AND SUBLETHAL DOSES OF GAMMA RADIATION. Okunewick, J. P.; Herrick, S. E. (Univ. of California, Los Angeles). Nature, 214: 514-15(Apr. 29, 1967). (UCLA-12-593).

The early recovery behavior of Pinus thunbergii trees exposed to 715 rads of acute gamma irradiation (^{60}Co) was previously reported. The present communication reports the later recovery behavior of the same trees during the first and second growing seasons after irradiation, and the behavior of similar trees subjected to 1,000 rads. During the entire period after irradiation the trees were kept in controlled conditions in a glasshouse. Measurements of branch and needle length are tabulated for the first year after irradiation with 715 rads. The distribution of new needles on the branches was definitely affected by the irradiation, leading to clumping at the end of the branch. In the second year after irradiation no significant differences in growth behavior were observed between trees irradiated with 715 rads and the control group. Interesting points arising from the study were that it is not necessary for the entire meristem to survive in order to ensure survival of the entire branch or plant. It is sufficient that enough cells survive to form a new meristem. Also that needles of pines markedly affected by irradiation were not shortened significantly. These points are discussed. The response to 1,000 rads was markedly different from the response to the lower dose. Mortality was characterized by immediate cessation of growth, followed by browning and loss of needles. After 10 weeks 75% of the trees were dead, and after 9 months 100%. (UK)

22777 IMPLICATION OF AUXIN IN THE UV-PROMOTED EXPANSION OF ETIOLATED BEAN LEAF DISKS. Spang, Henry A. (Ohio State Univ., Columbus). Physiol. Plant., 19: 672-7(1966).

Attempts were made to determine the mechanism involved in the uv-promoted expansion of etiolated bean leaf disks after the promotion of expansion of etiolated Phaseolus vulgaris leaf disks by uv radiation was confirmed. The optimum conditions for the effect were found to be 5-sec uv exposure followed by 24 hr of incubation at 25°C and pH 6.2. Macerations and sections of the treated and control disks indicated that the basis of the response was an increase in the number of cells in the uv-treated disks. Experiments with indolebutyric acid (IBA) and p-chlorophenoxyisobutyric acid (PCIB) indicated that uv apparently acts to reduce a superoptimal endogenous auxin level to an optimum level which results in promotion of the expansion. Thus, the combination of PCIB and uv reduced the effective auxin level below the optimum level and thus inhibited the expansion. Taking the concentrations above that which inhibited the promotion (5-sec uv exposure and 100 mg/l PCIB) and by adding more auxin (IBA) the response could be regained. Addition of further auxin to the optimum uv dose resulted in blocking the response. A combination of 2 suboptimal conditions (2-sec uv and 25 mg/l PCIB) resulted in promotion of the expansion even though independently they resulted in only a very slight promotion. (BBB)

22778 INVESTIGATION ON THE CONTRACTION OF CHLOROPLASTS IN MNIUM UNDULATUM (L.) WEIS. II. STUDIES ON ISOLATED CHLOROPLASTS. Zurzycki, J. (Jagiellonian Univ., Krakow). Acta Soc. Botan. Pol., 35: 281-91(1966).

The effect of uv, blue, and red light on isolated chloroplasts of this moss was examined. The action spectrum was determined by using the following wavelengths for irradiation of the chloroplasts: 333, 351, 362, 382, 400, 429, 442, 454, 470, 484, 506, 523, and 541 nm. The action spectrum was obtained by measuring contraction of the chloroplasts after irradiation at each of the wavelengths. The spectrum showed 2 peaks, at about 450 nm and between 360 and 380 nm. The effect of radiation was lowered between 400 and 430 nm and dropped considerably above 500 nm. Below 350 nm the criterion of activity could not be applied because no enlargement was noted in this part of the spectrum. In the region 350 to 380 nm the intensity of radiation used was too low to cause a distinct contraction. Thus there may be some error in the determination of absolute activity in the uv region but this would not change the general shape of the action spectrum. The action spectrum is similar to the absorption spectrum of riboflavin, suggesting that this pigment is active as the light absorbent for the contraction of chloroplasts. It was also shown that the increase in chloroplast size is controlled by photosynthetic phosphorylation and is inhibited by o-phenanthroline or NH_4 ions, and that the process of contraction can be selectively blocked by KI. (BBB)

22779 INDUCED MUTATION RATES WITH GAMMA RAYS AT A SPECIFIC LOCUS IN OATS. Wallace, A. T.; Luke, H. H. (Univ. of Florida, Gainesville). Contract AT(40-1)-2562. Crop Sci., 1: 93-6(1961).

Seeds of the Victorgrain variety of oats, which are susceptible to the fungus Helminthosporium victoriae, were irradiated with ^{60}Co γ rays and grown to maturity in isolation. The germinating seeds in the X_2 generation were treated with toxin produced by H. victoriae, and resistant seedlings were selected. These resistant seedlings represent induced mutations at the locus controlling susceptibility in the oat variety. When the seeds at 10% moisture were irradiated at 0, 9, 18, 27, and 36 kR at a rate of 4.5 kR/min, the induced mutation rates were 0, 10.4, 13.6, 0.9 and 5.1×10^{-4} per R per locus, respectively. When the seed moisture was 33%, obtained by hydration at 2°C, and irradiation was applied at 0, 4.5, 9, and 13.5 kR at a dose rate of 4.5 kR/min, the induced mutation rates were 0, 35.9, 10.9, and 1.5×10^{-3} per R/locus, respectively. These induced mutation rates were in the same order of magnitude as those reported for mice and Drosophila; did not increase linearly with increasing dose; were influenced by moisture content of the seeds at the time of irradiation; and were not influenced by the range in dose rate tested (20 to 4.5 kR/min). (BBB)

22780 AXILLARY BUDS IN NORMAL AND IRRADIATED APPLE AND PEAR. Pratt, Charlotte (New York State Agricultural Experiment Station, Geneva). Radiat. Bot., 7: 113-22 (Apr. 1967).

Dormant buds of apple and pear are convenient material to irradiate for the production of mutations or chimeral rearrangements. The sites of action of ionizing radiation are the apical meristem and the secondary bud primordia of the dormant bud. Such buds and growing shoot tips of normal and irradiated McIntosh (2x) and Northern Spy (2x) apples, their cytochimeras Kimball McIntosh (2-4-4-4) and Loop Spy (2-2-4-4), and Bartlett pear (2x) were sectioned or dissected. Apple scions received 0 to 2850 rad of x rays and pear scions were exposed to 0, 2000, 4000, or 6000 rad of γ rays. Dormant pear buds had seven bud primordia that would normally continue growth, while those of apple had only three. No bud primordium in a dormant bud had reached the mound stage. After irradiation of apple and pear, radiation-damaged cells were found in the subsurface central region of both apical and axillary meristems. Greatest damage occurred in layers II and III. Cells adjacent to the damage, notably those surrounding the damaged area of the shoot between the youngest three leaves and those adaxial to the older bud primordia, became meristematic. One or more secondary buds developed from the axils of pre-irradiation leaves 1 to 5 in apple and 1 to 10 in pear. In older recovering shoots an adventitious bud might arise on the stem, as suggested by one cauline bud. (auth)

22781 RADIATION-INDUCED CHANGES IN RESPIRATION OF CORN, WHEAT, SORGHUM, AND RADISH SEEDS DURING INITIAL STAGES OF GERMINATION IN RELATION TO SUBSEQUENT SEEDLING GROWTH. Woodstock, L. W.; Justice, O. L. (Dept. of Agriculture, Beltsville, Md.). Radiat. Bot., 7: 129-36 (Apr. 1967).

Seeds of corn, wheat, sorghum, and radish were exposed to 0-, 5-, 20- or 80-Krad doses of γ-radiation from a ^{60}Co source. Doses of 80 Krad caused marked inhibition in seedling growth and inhibited the rate of respiration in all four species. A decrease in oxygen uptake and an increase in R. Q. values, at this dose, could be detected within 6 hr after planting when respiration was measured in an atmosphere of 100 percent oxygen. Doses of 20-Krad caused no significant inhibition in seedling growth and did not inhibit respiration. Five Krad caused slight, but consistent, stimulations in seedling growth. At this dose, an increase in oxygen uptake, a decrease in R. Q. values, or both, was observed in corn, wheat, and sorghum, but not in radish seeds. (auth)

22782 RADIOSENSITIVITY AND INTERPHASE CHROMOSOME VOLUME IN THE GYMNOSPERMS. Capella, J. A.; Conger, A. D. (Univ. of Florida, Gainesville. Temple Univ., Philadelphia). Radiat. Bot., 7: 137-49(Apr. 1967).

The sensitivities to acute ^{60}Co γ-radiation of five species of gymnosperms were studied. The species were Pinus elliotti, Pinus palustris, Juniperus conferta, Podocarpus macrophylla, and Zamia floridana. The nuclear and interphase chromosome volumes (nuclear volume divided by chromosome number) were calculated from measurements of shoot meristematic nuclei for each species. The plants, which were 1 to 2 year seedlings or 1-year old rooted cuttings, received acute γ radiation, taking care to shield the roots and thus simulate irradiation under natural growing conditions. The gymnosperms are a very radiosensitive group of plants; the 50 percent lethal doses (LD_{50}) for the species studied ranged from 500 to 760 R. The correlation between radiosensitivity and nuclear (or interphase chromosome) volume for the species studied agreed well with values obtained from other acutely irradiated woody species. A general curve of survival vs. exposure (in units of LD_{50}'s) is given. It is useful for selecting in advance the appropriate exposures to deliver in order to obtain data in the exposure region of declining survival, if any exposure causing a given survival percentage is previously known or can be estimated. The data came from survival curves for 10 species of acutely irradiated woody plants. On the average, the LD_1 (99% survival exposure) is 0.53 times the LD_{37}, and the LD_{99} (1% survival exposure) is 1.47 the LD_{50}. (auth)

22783 UTILIZATION OF NEUTRONS IN RADIOBOTANICAL AND PLANT IMPROVEMENT RESEARCH IN THE EURATOM-ITAL ASSOCIATION. Contant, R. B.; de Zeeuw, D. (Instituut voor Toepassing van Atoomenergie in de Landbouw, Wageningen, Netherlands). Atoomenergie Haar Toepass., 9: 27-36(Feb. 1967). (In Dutch).

In radiobiological and radiogenetic studies in the higher plants, neutrons are extensively used. The energy release in biological materials, the RBE of neutrons, the radiation sensitivity, the utilization of neutrons in plant improvement, and the stimulating effect of large doses in histological and morphological changes in the irradiated organs were described. (tr-auth)

22784 GAMMA RADIATION EFFECTS ON THE GROWTH AND DEVELOPMENT OF SEEDLINGS OF VARIETY OF MAPLES AND BIRCHES. Kudzinau, M. A. Vestsi Akad. Navuk BSSR, Ser. Biol. Navuk, No. 3, 54-63(1966). (In Ukrainian).

Critical and lethal γ doses for various maples and birches were found to be: 10,000 R and 15,000 R for the ash-leaved maple; 15,000 and 60,000 R for the Tartar maple; 15,000 and 60,000 R for the Ginnal maple; 15,000 and 60,000 R for the Litvinov; 5,000 and 10,000 R for the Schmidt; and 5,000 and 10,000 R for the birch. Growth stimulating doses for yearling seedlings of ash-leaved and Ginnal maple were 500 and 1000 R, respectively. The initial stimulating effect of x radiation is followed by inhibited growth in later years. Sometimes the reverse situation occurs, growth is inhibited the first year but stimulated the following year. The period of growth is increased in the birches and reduced in maples. (R.V.J.)

22785 IMPORTANCE OF MACROMUTATIONS FOR PLANT BREEDING. I. EXAMPLES OF ALTERATION OF AWN LENGTH IN SPRING BARLEY MUTANTS IN A DIFFERENT GENETIC BACKGROUND. Gaul, H.; Hesemann, C. U. (Max-Planck-Institut fuer Zuechtungsforschung, Cologne). Z. Pflanzenzuecht., 55: 225-37(1966). (In German).

Three short-awned mutants of the Haisa II variety of Hordeum vulgare derived from x ray treated material were crossed with 5 varieties that differed from Haisa II to a greater or lesser extent genetically (MS crosses). The investigations included the F_2 and F_3 generations. Back crosses of the mutants with Haisa II (MH) and crosses of the varieties with Haisa II (SH) served as controls. From the results of the MH crosses it was concluded that the mutants were monogenic recessives in inheritance. Only long-awned plants occurred in the SH crosses. In the F_2 generation of all MS crosses a new type that did not occur in the control crosses appeared, viz., awns of intermediate length. Many forms with intermediate awns bred true. In the F_3 generation the variability of the mutant character was much greater than that in F_2, especially in one MS combination. In the mutant itself the range of variation of the mean values for single plants extended from an awn length of 2.5 to 3.8 cm. In the F_3 plants the mutant character varied from 0 (i.e., complete loss of awns) to 7.4 Cm; all intermediate grades between these extremes occurred. None of the various genetic models proposed by other authors are applicable to these results; in particular, they provide no explanation for the appearance of awnless forms. The results show that the mutant character short awns can be altered to a great extent by new gene interactions, both in a positive and negative direction. A large number of genes may be capable of causing variations in the phenotypic expression of this mutation. (BBB)

22786 INDUCED TRANSMISSIBLE MODIFICATIONS OF RADIOSENSITIVITY BY HEAT TREATMENT. Palenzona, D. L. (Univ., Bologna). Radiat. Bot., 7: 151-3(Apr. 1967).

Tomato seeds cv. Earliana were allowed to germinate at three different temperatures, i.e., 22, 27, and 34°C. There was no difference in the percentage of germinated seeds at the three temperatures. The radiosensitivity of the seeds of the next generation to doses of x rays ranging from 0 to 480,000 R was estimated by means of the germination rate. The results suggest that the highest temperature treatment modified the type of response to the irradiation. This phenomenon is attributed to changes induced by the temperature on the intracellular factors influencing the radiosensitivity. (auth)

22787 RATE OF REPRODUCTION AND SURVIVAL OF DUCKWEED LEMNA MINOR AFTER γ IRRADIATION. Kasinov, V. B. (Ioffe Inst. of Physics and Tech., Leningrad). Radiobiologiya, 6: 605-12(1966). (In Russian).

A method for the determination of the survival of duckweed based on the evaluation of the number of living cymes (from the combination of the most radiosensitive embryos) in the descendents of irradiated colonies was described. The dependence of the survival on the dose in Lemna minor was expressed by the sigmoid curve and $LD_{50/6}$ was approximately 7 kR. During maintenance of cultures irradiated with doses of 6 kR under conditions of continuous illumination an abrupt but reversible decrease of the reproduction rate was observed in the first days after irradiation. Preliminary maintenance of the cultures irradiated with the same dose in darkness eliminated this radiation effect. The radiosensitivity of the duckweed embryos depends on their size at the moment of irradiation. Even the most sensitive embryos show that individual sensitivities are dissimilar. For groups of embryos whose mortality rate was low to medium (36%), the distribution of mortality per group corresponds to the Poisson distribution. (tr-auth)

22788 NONRANDOM DISTRIBUTION OF X-RAY-INDUCED BREAKS IN THE CHROMOSOMES OF BELLEVALIA ROMANA. Glaess, Eberhard (Univ., Freiburg i B.). Port. Acta Biol., Ser. A, 8: 153-76(1963-4). (In German).

The effect of x rays (300 R) on chromosomes of B. romana ($2n = 8$) was studied in a total of 6651 metaphase plates. Depending on the time of observation (48, 72, 96 hr after irradiation), there was a decrease in the number of breaks observed on the A and B chromosomes. In the C and D chromosomes the number of breaks increased. A correlation between frequency of breaks and chromosomal length was observed in fragmentations as well as in chromosome and chromatid translocations. The breaks in ring chromosomes were not distributed at random. In all chromosomes of B. romana, the centromere was the region most frequently broken. (BBB)

22789 SOME DISTINGUISHING FEATURES OF THE INITIATION OF BIOLOGICAL DAMAGE BY PHOTON AND IONIZING RADIATION. Gray, L. H. (Mt. Vernon Hospital, Northwood, Eng.). pp 237-42 of Progress in Photobiology. Christensen, B. Chr.; Buchmann, B. (eds.). Amsterdam, Elsevier, 1961.

This review examines various features of induction of biologic changes in bacteria, viruses, and proliferative cells of higher plants and animals by visible, uv, and ionizing radiation. Stages of uv mutagenesis are discussed, and various hypotheses relating to the site of action of uv radiation are evaluated. The effects of uv light are compared with those of visible light and of ionizing radiation. For interpretation, studies with uv light offer an advantage over those with ionizing radiation in that by means of action spectra it is possible for any given type of biological response to specify the kind of molecule in which energy is primarily absorbed. By this test some forms of uv damage are seen to arise mainly from energy absorbed in protein, and others from energy absorbed in RNA, DNA, or nucleotides. The latter forms of damage are considered, including mutation, chromosome structural damage, and loss of reproductive integrity in viruses, bacteria, and the proliferative cells of higher plants and animals. Ultraviolet energy absorbed in simple nucleic acids or nucleotides is biologically efficient and photoreactivable. The uv energy absorbed in nucleo-protein is biologically inefficient (possibly because the energy of excitation is almost immediately transferred from the nucleic acid to the protein) and not photoreactivable. Nucleoprotein damage is generally oxygen dependent, whereas nucleic acid alone, whether excited by uv light or ionizing radiation, is only oxygen dependent in special circumstances, at least with respect to forms of chemical change which are important for its own subsequent duplication. Differences between mechanisms of initiation of damage by the different types of radiation are examined. Speculations are offered to explain the effects of uv on nucleic acids and their constituents. (BBB)

22790 MERISTEMS UNDER CONTINUOUS IRRADIATION. Clowes, F. A. L. (Oxford Univ.); Hall, E. J. Ann. Bot., 30: 243-51(1966).

Root tips of Vicia faba and Zea mays were subjected to continuous irradiation from Ra or ^{60}Co for long periods at various dose rates. The rates of mitosis and the damage to the chromosomes (assessed as percentages of cells with micronuclei) were measured in 4 regions of the meristems. In Zea, rates of mitosis are reduced under chronic irradiation, except in the quiescent center, and the cap initials are particularly sensitive. In Vicia, the main change in mitosis is that the quiescent center increases its rate, but at 12°C there is a slight stimulation of division all over the meristem. In Vicia increasing the dose rate or lowering the temperature increases the nuclear damage. At 10°C there is an increase in damage with accumulated dose per cell cycle, but the data at 12°C do not fall on the 19°C curve, suggesting that there may be a temperature effect on damage other than that caused by changing the duration of the cell cycle. The differences in radiosensitivity between the different regions of the meristem are due solely to differences in the rates of mitosis of the cells. (BBB)

22791 TUBE GROWTH FOLLOWING POLLEN IRRADIATION IN TRADESCANTIA. Vassileva-Dryanovska, O. A. (Agricultural Coll. of Sweden, Uppsala). Compt. Rend. Acad. Bulg. Sci., 19: 649-51(1966).

No previous studies in Tradescantia of the pollen tube growth and of the development of the generative nuclei from the stigma to the embryo sac following pollen irradiation are known. Consequently, the author followed the growth of pollen tubes and the changes of the male chromatin from the stigma to the embryo sac following pollen irradiation with x and gamma ray doses of 1,000 to 5,000,000 R. Flowers of diploid and tetraploid material of Tradescantia paludosa were pollinated with irradiated pollen and fixed in Carnoy from 1 hour to 10 days after pollination (14 fixations per variant). The paper gives an exhaustive description of the observed events. It shows among others that with higher doses the four half-chromatids can be separated from every chromosome and that the breakage can be interpreted as the consequence of half-chromatid breakage and interchanges. (JPRS)

22792 MUTATION EXPERIMENTS IN CULTIVATED PLANTS. XII. ON THE GENETIC BEHAVIOR OF SOME EARLY HEADING BARLEY MUTANTS. Mettin, Dieter (Univ., Halle-Saale, Ger.). Zuechter, 31: 83-9(June 15, 1961). (In German).

Radioinduced mutants were developed in the summer barley varieties Heines Haisa, Freya, and Ackermanns Donaria and in the winter variety Mahndorfer. The genetic aspects of 9 x-ray-induced early heading mutants of barley were studied. In crosses with original varieties all mutants showed monogenic segregation ratios in the F_2 generation. The early heading of 4 mutants was found to be due to a dominant allele, while 6 mutants were dependent on recessive alleles. In crosses of some mutants one with another, 4 different loci for early heading were identified. For them the genetic symbol mat (matura) or Mat was proposed. The combination-effect of 2 non-allelic genes was always additive and was manifested in a marked transgression. Plants with such genotypes seemed to be useless for breeding purposes. (BBB)

22793 LINKAGE STUDIES IN PISUM. III. LINKAGE OF THE MUTANT $AUREA_{RS}$. Blixt, Stig (Plant Breeding Inst., Weibullsholm, Sweden). Agri Hort. Genet., 24: 157-63(1966).

The aurea mutant, denoted $aurea_{RS}$ and representing line no. 5309, originated from x-ray treatment of the variety Weitor 1957 with 6000 rads. Immediately after germination, the mutant is almost chlorina, but changes rapidly over to the aurea type. The mutant is determined by a lethal gene and maintained through the heterozygotes. The segregation observed in X_3 and X_4 amounted to only 22 normal and 5 aurea plants, which is in accordance with a 3:1 segregation ratio. In cross B 242, the F_2 in the field segregated 87 normal: 4 aurea plants, a significant deficit. Also the F_3 generation grown in a greenhouse gave a significant deficit of mutant plants, the segregation observed being 68 normal: 10 aurea plants. The results of studies of the cross B 242, line 5309 x line 851, made to determine the localization of the gene responsible for the $aurea_{RS}$ mutant, are reported. The aurea gene was found to be most probably linked with the genes A, Cor, and Sal in chromosome I, in the sequence Sal-Cor-aurea-A. With respect to its position, it is assumed that it is the same gene as Lamprecht's au. (BBB)

22794 EFFECTS OF NON-IONIZING RADIATION ON EXPANSION OF DISKS FROM LEAVES OF DARK-GROWN BEAN PLANTS. Klein, Richard M.; Wansor, Julia (New York Botanical Garden, Bronx Park). Contract AT(30-1)-2587. Plant Physiol., 38: 5-10(Jan. 1963).

The effects of and interaction of visible and uv radiant energy on the expansion of disks cut from the primary leaves of dark grown bean (Phaseolus vulgaris) plants were investigated. Red and blue radiations were of equal effectiveness in inducing expansion; both were of equal effectiveness in inducing expansion; both were negated by far-red radiant energy. Red and blue light interacted in leaf disk expansion when presented sequentially or simultaneously. The order blue-red was more effective than either red + blue or red followed by blue. Polarization of blue, red, or far-red light in any plane relative to a reference vein increased the effectiveness of the light by one order of magnitude. Ultraviolet radiation induced expansion of leaf disks. This expansion was not under phytochrome control. Red, blue, and uv irradiations all induced disk enlargement by cell multiplication. The fact that uv radiation (254 mμ) induced expansion of leaf disks may be related to the finding that uv represses the capacity of plant tissues to respond to added auxins. If leaf disks contain excess levels of auxin through acropetal translocation from the cotyledons, uv-radiation-induced recalcitrance of the cells would reduce the biologically effective level of auxin to the level where it can function positively. The decrease in response with increasing uv irradiation would be expected as the cells become both more recalcitrant and as other metabolic systems are damaged by the radiation. (BBB)

22795 INDUCTION OF VARIABILITY FOR SPIKELET STERILITY IN HORDEUM. Bansal, H. C.; Natarajan, A. T. (Indian Agricultural Research Inst., Delhi). Indian J. Genet. Plant Breed., 25: No. 1, 65-70(Mar. 1965).

Experiments were performed to evaluate the variability that exists in triplet fertility in Hordeum irregulare and to ascertain the extent and variability of floret fertility in second generations after treatment with physical and chemical mutagens. Variability was analyzed in the progeny of 50 control plants and compared with the variability in M_1 generations of mutagen treated seeds. One hundred seeds (moisture content 13 to 14%) were treated with each of three mutagens: seeds were exposed to 20,000 R x radiation, fast neutrons, and ethyl methanesulfonate (EMS). EMS treatments were carried out by soaking seeds in two concentrations (0.25 and 0.35%) of aqueous solutions buffered at pH 6.5 for 24 hr. Control and treated seeds were sown and the first spike from resulting plants was harvested. For analysis of variability a completely randomized experiment was outlined for the five treatments. First spikes of all available plants in all progenies were scored for fertility index. Treatment differences in respect to mean fertility were seen to be highly significant. Most of the differences between treated and control rows were derived from EMS treatments; no great difference seemed to exist between controls and progenies from x-irradiated or fast-neutron treated seeds. It was noted that the fertility index dropped in all but x-irradiated materials; the fertility index was most strongly effected by EMS treatment. It was also noted that marked variation within and between progenies within each treatment, particularly in progenies resulting from EMS treated M_1 seed, occurred even after removal of all drastic morphological variants. EMS treatment produced a differential effect on different meristems whereas the radiation effects appeared to be uniform. EMS was found to be the most potent among the treatments tried for induction of greater variance. (B.H.S.)

22796 STUDIES ON RADIOSENSITIVITY OF FOREST TREES. 2. GROWTH AND SOMATIC MUTATIONS OF ALNUS, POPULUS, AND BETULA SPECIES UNDER CHRONIC GAMMA IRRADIATION IN A GAMMA FIELD. Oba, Kihachiro (Inst. of Radiation Breeding, Omiya, Japan); Murai, Masafumi. Nippon Ringaku Kaishi, 48: No. 1, 12-19(Jan. 1966). (In Japanese).

Experiments were conducted to obtain some information on the breeding of broad leaved trees under chronic γ irradiation during the period 1963 to 1965. One-year old saplings of Alnus and Betula species were planted, and cuttings of Populus species were raised directly in the experimental field. Hundred percent lethal dose rate was estimated as 60 to 160 R/day in the second year, and 60 to 80 R/day in the third year. Dose rates varied for each tree species tested. Tree height growth was severely inhibited at the high dose rate and the dose rate that reduced 50% of the tree height growth in 1964 and 1965 was about 60 to 80 R/day (compared with interpolated values) in all tree species. Percentages of saplings with blind buds in the main stem and with abnormal internodal branchings were checked. Percentages varied according to tree species and the increase was very steep at such dose rates as 50 to 200 R/day. Leaf form of Populus alba narrowed significantly with increasing dose rate, but no correlation was observed in other tree species between the leaf index and the dose rate. Seven somatic mutations were detected after a cut back treatment in 1965. Six out of seven were mere variegation of leaves, and the other one, in Populus simonii, showed narrow light green leaves that developed on a sector of a stem, and that appeared in every 5th leaf on the sector. All somatic mutations were detected in the plants receiving doses that ranged from 50 to 70 R/day: the optimum dose rate for the causation of somatic mutations in broad leaved trees under chronic gamma irradiation. (NSA of Japan)

22797 CYTOTOXIC EFFECTS OF EXTRACTS FROM GAMMA-IRRADIATED PINEAPPLES. Makinen, Y.; Upadhya, M. D.; Brewbaker, J. L. (Univ. of Hawaii, Honolulu). Nature, 214: 413(Apr. 22, 1967).

Substances with cytotoxic or mutagenic properties have been reported in irradiated biological materials, although there is no evidence of their toxicity to animals consuming them. Treatment with gamma radiation was shown to disinfest as well as improve the storage life of pineapples, without producing undesirable changes in colour or flavour. Studies are described to assess the significance of cytotoxins induced in the fruit by gamma radiation, including the ability to catabolize such cytotoxins. The fruit was irradiated by stages up to 500 kR (4.5 kR/min) in the Hawaii Research Irradiator. Half of the fruits from each irradiation were stored for 8 days at 65°F. Juice was extracted immediately after irradiation from the remaining fruits, and applied to onion roots; frequencies of mitotic and chromosome aberrations in the onion root cells were scored as measures of cytotoxicity. Mitotic frequencies were markedly depressed by these juices and showed a correlation with dose. Juices from fruits stored for 8 days did not depress mitotic frequency significantly, except in the higher dose

ranges, and there appeared to be a stimulation in the middle dose ranges. A study was also made on the frequency and types of chromosome breakages. Almost all breaks occurred at the kinetochore. There was a significant increase in frequency of breaks in root tips grown on the immediately extracted juice for all doses. For extracts stored for 8 days, those from middle range irradiations gave breakage frequencies similar to the controls; the mutagenicity of extracts from the higher dose ranges remained unchanged during storage. The results indicate a high degree of detoxification of cytotoxins during 8 days' storage of fruits irradiated in the middle range, but very little for the higher doses. The action of enzymes in the destruction of cytotoxins is discussed. The findings need not necessarily have any correlation with regard to consumption of the irradiated fruits. The nature of the cytotoxic substances formed is not known. (UK)

22798 EFFECTS OF SMALL DOSES OF IONIZING RADIATION ON THE BIOSYNTHESIS OF ADENOSINTRIPHOSPHATE HEXOSEPHOSPHATES AND DESOXYRIBONUCLEONIC ACID IN COTTON CELL ORGANELLES. Arslanova, S. V. (Inst. of Experimental Biology of Plants, Tashkent). Uz. Biol. Zh., No. 5, 3-6(1966). (In Russian).

Effects of small doses of γ radiation on the biosynthesis of adenosintriphosphates (ATP) and hexosephosphates in mitochondria and nuclei, and the DNA synthesis in the nuclei of the root cells were investigated using two types of cotton (the late-ripening, more radiosensitive C-1622 and fast-ripening and more radioresistant 1306-DV). The results showed that small doses of γ radiation accelerated DNA synthesis in both types of cotton; this in turn stimulated the activity of enzymes stimulating the production of ATP and hexosephosphoric acid in mitochondria and cotton cell nuclei. The increased cell energies resulted in larger accumulation of protein, sugar, and vitamins producing as a result a better crop. (R.V.J.)

22799 EFFECTS OF γ RADIATION ON HEREDITARY CHARACTERISTICS IN HYBRID COTTON SEEDS. Nazirov, N. N.; Perepelenko, S. D. (Inst. of Experimental Biology of Plants, Tashkent). Uz. Biol. Zh., No. 5, 11-15(1966). (In Russian).

Gamma radiation effects on radiosensitivity and hereditary characteristics of hybrid cotton seeds were studied with C-460 and 1306-DV cotton of G. hirsutum type exposed to 25 R/sec. The results showed that fast-ripening 1306-DV was 2 to 3 times more radioresistant than late-ripening C-460. The hybrid plants independent of the combinations inherited the radioresistance from the more radioresistant parent; moreover, the hybrid progeny also inherited the fast-ripening quality of one parent and large seed-case of the other. (R.V.J.)

22800 EFFECTS OF GAMMA RAYS ON PRODUCTIVITY OF PEPPERMINT. Ozola, S. M.; Eizenberga, V. T. (Riga Medical Inst. Inst. of Biology, Riga). Latv. Psr Zinat. Akad. Vestis, No. 12, 120-2(1966). (In Russian).

A study was made of the effect of various doses of gamma radiation on the yield of leaves and volatile oil content at differing times following mint irradiation. The study of the effect of various doses and intensity levels of gamma irradiation (dose intensity 0.025 R per sec) indicated that mint leaf yield and oil content increased at 5000 R and 10,000 R doses but fell in comparison to control at a 20,000 R dose. (auth)

Radiation Effects on Microorganisms

Refer also to abstracts 22378, 22386, 22653, and 22789.

22801 (NYO-3102-10) RADIATION SENSITIVITY OF THE CILIATE SPATHIDIUM SPATHULA. Progress Report. Williams, Donald B. (Vassar Coll., Poughkeepsie, N. Y. Dept. of Biology. Oak Ridge National Lab., Tenn.). Aug. 1, 1966. Contract AT(30-1)-3102. 10p. Dep. mn. CFSTI $3.00 cy, $0.65 mn.

Lines of two clones of Spathidium spathula collected from widely separated areas were cultivated vegetatively, without sexual reproduction or encystment, for 1, 2, 4, 6, 8, 10, and 12 weeks. The initial division rate increased the first day after excystment and was maintained at the same level for the duration of cultivation. Variations in cell size increased with extended cultivation, and the cells in older lines tended to be smaller than normal. After 3 to 5 weeks of cultivation both clones showed increased sensitivity to x radiation. (H.L.W.)

22802 (UCB-34P116-2) PHOTOCHEMISTRY OF ENZYMES AND VIRUSES. Progress Report, February 1, 1965-December 31, 1966. Evans, Neil; McLaren, A.; Werbin, Harold (California Univ., Berkeley. Dept. of Soils and Plant Nutrition). Jan. 31, 1967. Contract AT(11-1)-34. 166p. Dep. mn. CFSTI $3.00 cy, $0.65 mn.

Progress is reported on studies of the photochemistry of enzymes and viruses. A formula was derived that predicts the quantum yields for the uv inactivation of some enzymes and tobacco mosaic virus protein. Reaction mechanisms involved in the photoreactivation of uv-inactivated RNA from tobacco mosaic virus were studied on leaves of Chenopodium, pinto bean, and tobacco. There was greater photoreactivation on tobacco leaves than on the leaves of the other two plants. The quantum yield for the inactivation of the nucleic acid was about the same regardless of which plant was host when leaves were infected and left in the dark. It was concluded that this finding indicates the lack of dark recovery mechanisms in plant leaves for repair of uv-inactivated tobacco mosaic virus RNA. Tobacco mosaic virus RNA was exposed to uv and specifically labeled with ^{14}C-uracil and degraded enzymatically in an attempt to identify uracil derived photoproducts, but no uridylic acid hydrate was detected. No evidence of photorecovery was found in uv irradiated RNA from an RNA-containing bacteriophage assayed in its host Pseudomonas aeruginosa. The photoreactivation of a uv irradiated DNA virus that infects the blue-green algae Plectonema baryanum resulted from exposure to white or blue light, but not from exposure to red or black light. Since red light supports photosynthesis, it was concluded there is no interdependence between photosynthesis and photoreactivation and that different mechanisms are involved in the photorepair of algae and viral nucleic acids. Equipment and procedures used in studies on the photochemistry of enzymes and viruses are described. (C.H.)

22803 LETHAL PHOTOSENSITIZATION OF MICROORGANISMS WITH LIGHT FROM A CONTINUOUS-WAVE GAS LASER. Macmillan, James D.; Maxwell, W. Andrew; Chichester, C. O. (Univ. of California, Davis). Photochem. Photobiol., 5: 555-65(July 1966).

Eleven strains of microorganisms were examined for their susceptibility to death by irradiation with 21 to 30 mw of light at 6328 Å from a continuous-wave gas laser. Washed cells of seven species were rapidly killed when irradiated aerobically in aqueous solutions of toluidine blue: Sarcina lutea, Escherichia coli, Chromobacterium violaceum, Arthrobacter atrocyanus, Pseudomonas aeruginosa, Saccharomyces cerevisiae, and Rhodotorula glutinis. Cells remained viable when irradiated anerobically in toluidine blue. This is not proof that oxygen is required for death since toluidine blue is subject to reduction to the leuco form under anerobic conditions. None of the microbes tested, including cells of Bacillus cereus, Rhodospirillum rubrum, and Euglena gracilis, was killed in aerated suspensions without toluidine blue. Thus, it is unlikely that any strain has an endogenous photosensitizer capable of acting at 6328 Å. However, more than 95% of the cells of R. rubrum lost their motility. A colorless mutant of S. lutea began dying 10 min faster than the wild strain, which is known to be protected from photosensitized death by carotenoids for at least 2 hr when irradiated in toluidine blue with 1000 ft-candles of tungsten light. Since toluidine blue is bleached in irradiated cell suspensions, logarithmic death ceases within an hour with 2.5×10^{-6} M toluidine blue. Yeasts are less susceptible than bacteria, exhibiting longer lags before death begins. The size of colonies produced by irradiated yeast cells decreases with irradiation time. This suggests that multiple hits are required for death. (BBB)

22804 RELATION BETWEEN THE LOSS OF ACID-FASTNESS DUE TO ULTRAVIOLET IRRADIATION AND THE PATHOGENICITY OF TUBERCLE BACILLI. Murohashi, Toyoho; Yoshida, Konosuke (National Inst. of Health, Tokyo). Amer. Rev. Respirat. Dis., 94: 86-93(July 1966).

Studies on the effect of uv (2537 Å) irradiation on the acid-fastness of mycobacteria suggested a relation between the virulence of tubercle bacilli and the irradiation time required for the complete loss of acid-fastness. Avirulent or attenuated strains, such as H37Ra and BCG, loss all acid-fastness within a shorter irradiation time than the virulent strains, such as H37Rv, H2, and Ravenel. If this phenomenon is common to mammalian tubercle bacilli, then the term virulence of tubercle bacilli may be interpreted in molecular terms as a component of the cell wall structure that is part of the bacterial cell. Supplemental observations on the microscopic level showed that uv irradiation facilitated the penetration of dye molecules through the cell wall as the result of the destruction by uv energy. (BBB)

22805 THE ABSENCE OF A POSTIRRADIATION RADIOSENSITIZING OXYGEN EFFECT FOLLOWING X-IRRADIATION OF THE BACTERIA CELL. Mikhel'son, V. M.; Paribok, V. P. (Inst. of Cytology, Leningrad). Tsitologiya, 9: 454-8(Apr. 1967). (In Russian).

A suspension of the bacteria E. coli B/r taken in the concentration of 5 to 7.5×10^4 cells per ml was irradiated (RUM-11 device, 180 kV, 20 mA, 1000 R/min, HVL-3.4 mm Al) to 15, 30, and 45 kR during a permanent transfusion of pure nitrogen. Fol-

lowing irradiation, the suspension was transfused using oxygen for 1 min and then nitrogen for 10 min, and was then placed in a chamber filled with pure argon. Control groups showed no oxygen transfusion. The bacterial colonies in the chamber showed no evidence that oxygen postirradiation increased damage. It was concluded that irradiation produced no long-term oxygen-dependent damage. (TSS)

22806 THE OCCURRENCE AND GROWTH OF STAPHYLOCOCCI ON PACKED BACON, WITH SPECIAL REFERENCE TO STAPHYLOCOCCUS AUREUS. Eddy, B. P.; Ingram, M. (Low Temperature Research Station, Cambridge, Eng.). J. Appl. Bacteriol., 25: 237-47(Aug. 1962).

S. aureus occurs and survives in bacon-curing brines and may be found on vacuum-packed bacon. Under anaerobic conditions it competes with the indigenous flora of the bacon; its growth is favored by low numbers of other organisms and by high storage temperatures. Food-poisoning strains of staphylococci failed to grow when introduced in vacuum-packed bacon. Two possible reasons were suggested for this failure of the introduced staphylococci to develop: either the bacon was unsuitable as a substrate, or the presence of other bacteria on the bacon caused an inhibition. To distinguish these possibilities, inoculations were made into packs in which the bacteria on the bacon had first been killed, and into parallel untreated controls. Unsmoked and smoked bacon samples from the same factory were sterilized by irradiation (10 Mrad), inoculated with a food-poisoning strain at a level of about 10^4/g, and stored at 25°. After incubation for 1, 2, and 5 days, different cans were taken as samples and dilutions of homogenates of the contents were plated on agar and incubated at 44°. In 5 days there was roughly a 1000-fold increase in this count ($10^4 - 10^7$/g), there being little difference between the samples of green and smoked bacon. The experiment was then repeated in a modified form. Unsmoked and smoked bacon samples from another factory were inoculated as above both with and without prior sterilization with 5 Mrad. The results were similar to those of the first experiment except that the staphylococci grew more slowly on the smoked bacon. A similar experiment was carried out in which the bacon (from a third factory) received only a pasteurizing dose (1 Mrad), so that its indigenous flora was only reduced in numbers, not eliminated. The results showed again that there is less growth of staphylococci where the normal flora are not reduced, and especially on the smoked bacon. It is evident that even severe irradiation treatments did not produce inhibitory substances in the bacon, nor was there any detectable destruction of the nitrite. S. aureus grows well on bacon stored anaerobically at 25° and more rapidly and attained greater numbers when the bacon had been partially or wholly sterilized by irradiation. (BBB)

22807 ULTRAVIOLET-INDUCED CHANGES IN THE INFECTIVITY OF AGROBACTERIUM TUMEFACIENS. Heberlein, Gary T.; Lippincott, James A. (Northwestern Univ., Evanston, Ill.). J. Bacteriol., 93: 1246-53(Apr. 1967).

The infectivity of Agrobacterium tumefaciens strain B6 irradiated with shortwavelength ultraviolet light was followed as a function of dose. Previously reported enhancements of B6 infectivity by ultraviolet irradiation, in samples inoculated after 1.75 hr of dark incubation at 27 C, or immediately following irradiation, were found to occur most frequently after losses in cell viability of 60% and of 90% or more, respectively. Changes in colony-forming ability and tumor-initiating ability with increasing dose showed no obvious correlation until the maximal infectivity promotion of samples inoculated immediately after irradiation was reached. Thereafter, both bacterial responses typically decreased in parallel. With low dose rates, infectivity promotions were obtained with less than 10% loss in cell viability. Data for tumor appearance and tumor growth resulting from inoculations with irradiated cultures showed no significant differences from controls, nor did the age of the bacterial culture or age of the host plant influence the response. The infectivity promotion appeared to result from an increase in the proportion of viable cells that will subsequently initiate tumors. The characteristics of this ultraviolet infectivity promotion were shown to be most similar to those found in prophage and bacteriocin induction. (auth)

22808 ULTRAVIOLET-SENSITIVE TARGETS IN THE ENZYME-SYNTHESIZING APPARATUS OF ESCHERICHIA COLI. Pardee, Arthur B.; Prestidge, Louise S. (Princeton Univ., N. J.). J. Bacteriol., 93: 1210-19(Apr. 1967).

Inhibition by ultraviolet light of β-galactosidase and alkaline phosphatase synthesis was investigated in both ultraviolet (UV)-sensitive and UV-resistant (wild-type) Escherichia coli, with the objective of determining the sensitivity of various targets. Kinetics of enzyme formation by unmated bacteria and in mating systems, in which the donor provided the specific genetic material and the recipient the cytoplasm, permit the following conclusions regarding the sensitivity of various targets. Catabolite repression resulting from UV damage caused most of the inhibition of β-galactosidase formation. When it was largely eliminated by a step-down in nutrition, the principal target in UV-sensitive bacteria appeared to be the structural gene ($lacZ^+$), but damage to the cytoplasm was also important. Transitory inhibition by inactivation of messenger ribonucleic acid was also observed. In wild-type bacteria, repair reduced the importance of lesions in deoxyribonucleic acid sufficiently that cytoplasmic damage appeared to be at least as important. Repair occurred within 10 min, as shown by recovery of enzyme synthesizing ability. Caffeine and proflavine prevented recovery. Newly mated bacteria responded to irradiation very differently from unmated bacteria. The β-galactosidase or alkaline phosphatase structural gene ($lacZ^+$ or $phoP^+$) was much more inhibited after it was transferred than it was in unmated bacteria. This sensitivity seemed to depend on a sensitive state of the injected material, rather than on a different physiological condition of the entire zygote. Irradiation of recipient uvr^+ bacteria much more strongly inhibited expression of injected genes than if the F^- was uvr^-. Studies on mating systems were not considered very useful for learning about the function of unmated bacteria. (auth)

22809 POST-IRRADIATION RECOVERY OF THE CELL. I. EFFECT OF PREIRRADIATION CULTIVATION CONDITIONS ON THE REPAIR OF RADIATION DAMAGE IN ESCHERICHIA COLI B. Zhestyanikov, V. D.; Rezvaya, S. P. (Inst. of Cytology, Leningrad). Tsitologiya, 9: 299-306(Mar. 1967). (In Russian).

A cultivation of E. coli B on the minimal medium M-9 at 37°C or on the nutrient medium at 43.5° before irradiation was shown to result in an increase of the survival of x-irradiated bacteria as compared with the control pre-irradiation incubation on the nutrient medium at 37°. After irradiation the survival rate was found to be as high as in the case of maximal repair of the control. A similar increase in the survival rate of E. coli B was observed when the bacteria taken in the logarithmic phase, but not in the stationary one, were grown at 43.5° only for the very last 1.5–3 hrs (during the previous 10 hrs the cultivation temperature was 37°). The transfer of E. coli B cultivated at 43.5° during the last 1.5–3 hrs to conditions of 37° eliminates partially the effect of growth at conditions of elevated temperatures before irradiation. In the case of α-irradiation, the cultivation on M-9 and on the nutrient medium at 43.5° before irradiation did not increase the survival rate of bacteria as compared with the control (in the latter case the sensitivity of bacteria to α-rays was slightly increased). As no repair was observed after α-irradiation, the increase in the survival number of bacteria after X-irradiation related to changes in cultivation conditions before irradiation may be due to the postirradiation recovery. The results obtained may be explained by the initiation of metabolic mechanisms which determine the activity of the reparation system of the cell. (auth)

22810 CROSS-INDUCTION OF ESCHERICHIA COLI LYSOGENS BY AN ULTRAVIOLET IRRADIATION PRODUCT. I. THE DISPENSABILITY OF CONCURRENT MACROMOLECULAR SYNTHESES IN THE FORMATION OF A METABOLICALLY UNSTABLE INDUCER. Ryan, Ann M. (Columbia Univ., New York). Biochim. Biophys. Acta, 138: 140-50(Mar. 29, 1967).

Two approaches were adopted in an attempt to define an ultraviolet irradiation product which induces recipient lysogens when it is transferred from a male strain during bacterial conjugation (cross-induction). The metabolic stability of the prophage-inducing activity was determined and the requirement for concurrent macromolecular syntheses in its formation was evaluated from the effect of specific inhibitions established in the donors prior to irradiation. A diphasic decay pattern for the transferable inducer was observed. An overall half-life of 14 min in the absence of glucose was reduced to 9 min in its presence. The second phase of decay was seen only when aeration was continued after irradiation. A more rapid early decline occurred in versene-treated males. No reduction in inducing potential occurred when inhibition of nucleic acid synthesis was established by 5-hydroxyuridine or 6-azauracil. Complete inhibition of net protein synthesis by chloramphenicol eliminated cross-inducing activity. Some diminution occurred in puromycin-inhibited male cultures yet inhibition by 5-methyltryptophan was without effect. Exposure of males to 5-fluorouracil produced a dose-dependent decrease in the cross-inducing activity assayed subsequent to irradiation. Addition of actinomycin before or immediately after irradiation did not prevent cross-induction by irradiated versene-treated males. The data outlined suggest that the transferable inducer is either a small molecule or a preexisting macromolecule which has been modified by the irradiation. (auth)

22811 ANTIBIOTIC EDEINE: I. ISOLATION OF INDUCED HIGH ACTIVITY MUTANT OF BACILLUS BREVIS Vm4. Chmara,

Henryk; Borowski, Edward (Technical Univ., Gdansk, Poland). Acta Microbiol. Pol., 15: 223-34(1966).

The production of a radioinduced mutant of Bacillus brevis yielding increased amounts of antibiotic is described. The rate of mutation increased with the lethal effect of the mutagenic agent. The best results could be obtained at the survival level of 0.01 to 0.02%. The survival curve for the Vm4 strain irradiated with uv was determined. The yield of edeine in broth cultures of the wild strain of Bacillus brevis Vm4 was low and isolation of the antibiotic was difficult due to the presence of peptone in the medium. The mutants described were induced by repeated uv irradiation. The most active mutant (No. 587) gave a yield of edeine 16 times higher than that of the wild strain. It grew well and produced increased amount of the edeine also in synthetic medium with asparagine as nitrogen source. No mutants with higher activity could be obtained with further uv irradiation or with subsequent nitrogen mustard treatment. (BBB)

22812 BIOPHYSICAL ASPECTS OF CLOSTRIDIA. Grecz, N. (Illinois Inst. of Tech., Chicago). J. Appl. Bacteriol., 28: 17-35 (Apr. 1965).

Factors affecting the resistance of Clostridia spores to ionizing radiation and other physical and chemical agents are reviewed. A table is provided which tabulates and compares properties related to the bactericidal and sporidical action of heat and radiation on micro-organisms in aqueous suspensions. These data emphasize the existence of differences in the lethal effect of the two energies. However, there are some apparent similarities, which are discussed. There appears to be an interaction of the basic properties of resistance when mild heat and radiation are applied simultaneously, e.g., the pH dependence of survival shows an identical pattern. This property is particularly significant in terms of basic thermodynamic processes involved in the resistance of spores to heat and ionizing radiations. Among the many well-defined differences in the basic properties of heat vs radiation resistance of spores, the behavior of dipicolinic acid (DPA) is emphasized. Release of DPA has generally been associated with heat resistance of spores, but it appears to have no direct relation to radiation resistance of bacterial spores. Variations in radioresistance of different Clostridium botulinum strains are discussed. Substrate and temperature appear to affect radiation resistance of spores at the intracellular molecular level. Organic molecules in the medium may compete for radicals and thus eliminate much of the indirect action of radiation. Alternatively, the organic molecules themselves may be converted into harmful radicals and thus enhance the radiation inactivation of spores. Low temperatures appear to retard considerably radical and electron migration and, perhaps, also to reduce the chemical activity of radicals. (BBB)

22813 DEFECTIVE BIOTIN-TRANSDUCING MUTANTS OF BACTERIOPHAGE LAMBDA. Fuerst, C. R. (Ontario Cancer Inst., Toronto). Virology, 30: 581-3(Nov. 1966).

Transduction by lambda phage of Escherichia coli genes of the galactose (Gal) operon is carried out by genetically defective particles. In defective galactose-transducing mutants (λdgs) genetic cross-over may occur between the λ prophage and host chromosome at a point outside of the region of phage and host homology within which excision of prophage should occur in the normal course of phage induction. Since phage genomes which have picked up Gal genes are defective, i.e., unable to produce mature infective particles in the absence of helper phage, the phage material lost in the abnormal excision event includes phage genes that have an essential role in λ development. Biotin-transducing mutants of λ are described which are defective, but differ from λdgs as to the region of the λ genome from which phage genes have been deleted. The donor was strain Y10 of E. coli K12: $Gal^+(\lambda)^+Bio^+UV^rS^s$. Lysates used in transduction assays were prepared by uv induction. The recipient strains were isolated from defective lysogens of Y10 in a study of prophage during and after uv irradiation. Two cured isolates, designated T50-1 and T5-2, were found to require exogenous biotin for growth, to be uv sensitive, and lack the ability to carry out host-cell reactivation of uv-irradiated phages. Both isolates also failed to undergo lysogenization by λ with normal efficiency. These findings suggest that the 2 strains have a chromosomal deletion involving the λ attachment site and the genetic markers Bio and uv, all of which appear to be closely linked. (BBB)

22814 ABNORMAL METABOLIC RESPONSE TO ULTRAVIOLET LIGHT OF A RECOMBINATION DEFICIENT MUTANT OF ESCHERICHIA COLI K12. Clark, Alvin J. (Univ. of California, Berkeley); Chamberlin, Michael; Boyce, Richard P.; Howard-Flanders, Paul. J. Mol. Biol., 19: 442-54(Aug. 1966).

Experiments were performed to discover how uv irradiation kills cells of a Rec^- strain of E. coli and to deduce the nature of the defect responsible for the increased sensitivity of the Rec^- cells to uv irradiation. A given dose of uv irradiation was found to produce as many pyrimidine-dimer-containing photoproducts in the DNA of the Rec^- strain JC1569 as it does in the related Rec^+ strain JC1557. Both strains excise dimer-containing photoproducts from their DNA to the same extent. In comparison with JC1557, ca 30 times as much DNA of the Rec^- strain is degraded per unit dose of uv light. Perhaps as a result of this excess uv-induced degradation, irradiation Rec^- cells do not incorporate appreciable amounts of exogenous thymidine or thymine into DNA and have few survivors following exposure to an uv dose which almost all Rec^+ cells survive. A numerical argument is offered to establish the ability of Rec^- cells successfully to replace excised pyrimidine-dimer-containing regions of the DNA with normal nucleotide residues. No effect of the rec^- mutation in JC1569 was found on the level of activity of the following enzymes: endonuclease I, exonuclease I, exonuclease III and DNA phosphatase, and DNA polymerase and exonuclease II. (BBB)

22815 NORMAL REPLICATION OF DNA AFTER REPAIR REPLICATION IN BACTERIA. Hanawalt, P. C. (Stanford Univ., Calif.). Nature, 214: 269-70(Apr. 15, 1967).

An early step in the dark repair of ultra-violet damaged DNA in bacteria is the excision of the damaged single strand regions. It has been postulated that a later step involved replacement of the excised segments with undamaged deoxyribonucleotides, utilizing complementary base pairing with the intact single strand. Direct physical evidence for this repolymerization step was obtained using the technique of DNA density labeling with 5-bromouracil and density distribution analysis in caesium chloride density gradients to distinguish semiconservative replication from the nonconservative mode of repair replication. The belief that this was the postulated repair synthesis step was strengthened by the results of a number of control experiments. An additional control experiment is reported that demonstrates that the DNA molecules damaged by ultra violet-irradiation, that have undergone nonconservative replication, were capable of normal semiconservative replication. Cultures of E. coli strain TAU-bar were employed in the experiment, together with ^{14}C-labeled 5-bromouracil and tritiated thymine. It was not demonstrated that the "repaired" DNA was biologically functional; however this appeared to be the case from survival level data. (UKAE)

22816 THE DOSE-RESPONSE RELATION FOR THE PHOTOREACTIVATION OF ULTRAVIOLET-INACTIVATED STATIONARY PHASE TETRAHYMENA PYRIFORMIS. Calkins, John (Univ. of Kentucky, Lexington). Photochem. Photobiol., 5: 787-95 (Oct. 1966).

Various mechanisms which have been postulated to explain photoreactivation kinetics are considered in terms of kinetic data obtained for photoreactivation of the lethal effect of uv light on T. pyriformis. The dose-response relation appeared to be first order (single-hit). First-order photoreactivation kinetics have been found in some other systems and are difficult to reconcile with current knowledge about other aspects of photoreactivation. It is suggested that the postulate that the apparent single-hit nature of photoreactivation kinetics arises from a certain distribution of sensitivities of the inactivated organisms for photoreactivation fits best with current theories of the biological action of uv light and its photoreversal. If there were some underlying basis for such a distribution of sensitivities, it would depend on the physical or chemical nature of the uv lesions, and it should be possible to distort the distribution of lesions in a population to render the reactivable population more homogeneous. The trigger mechanism seems to be the simplest explanation of single-hit kinetics, but experiments in vitro support a lesion-by-lesion reactivation different from a trigger mechanism. The photoreactiving-enzyme: uv-damaged DNA complex, when triggered by the absorption of one photon of reactivating light, would lead to the correction of enough damaged DNA to render the organism viable. Because of more triggers following higher uv doses an increasing fixed photoreactivation dose efficiency would be expected in contrast to the observed reduction of photoreactivation efficiency with increasing uv dose. (BBB)

22817 GENETIC INTERACTION BETWEEN INFLUENZA A VIRUSES OF HUMAN AND ANIMAL ORIGIN. Tumova, B. (Inst. of Epidemiology and Microbiology, Prague). Virology, 27: 253-61(Nov. 1965).

The plague-forming activity of uv-inactivated avian influenza A viruses (classical fowl plague and A/Turkey/England/63) was reactivated by various serotypes of influenza A viruses of human, porcine, equine, and avian origins. Clones obtained after multiple cycles of uv inactivation and rescue of fowl plague virus (FPV) in cross-reactivation experiments carried out in chick embryo cell cultures with UV-FPV and living A2 virus maintained the plague-forming ability of FPV, acquired the heat-labile hemagglutinin of the A2 parent and exhibited strain-specific antigens of both viruses. The phenotypic expression of both traits transferred from the A2 parent was gradual and increased in degree with each cycle of

cross reactivation. The A2 hemagglutinin marker was unstable and was inherited independently of the antigenic marker, which was maintained through many plague-purification cycles. (BBB)

22818 PRODUCTION OF MUTATIONS WITH X RAYS BY IRRADIATION OF FREE KAPPA BACTERIOPHAGE UNDER VARIOUS CONDITIONS. Rueger, W.; Kaplan, R. W. (Univ., Frankfurt am Main). Z. Allgem. Mikrobiol., 6: 253-69(1966). (In German).

A comparison was made of mutations produced by chemical agents, nonionizing and ionizing radiations in Serratia marcescens κ phage. X irradiation of extracellular κ phage in a 0.01M solution of thiourea (TH) or in nutrient broth (NB) induced several mutation types (c, b, e) when the plating host was Serratia strain HY. The types c and b were produced by 1 hit, while the concave dose curve of the e type indicated 3 hits. UV irradiation induced all 3 types by 2 hits. Inactivation by either form of radiation was brought about by 1 hit. The x-ray induced premutations (and lethal lesions) were stable to post-treatment of the free phage with light, heat, or peroxidase. If strain CN was used as host, mutations were not induced by x rays or uv; this effect was due to cancellation of all induced premutations in this strain. Inactivation of the phage by x irradiation was much more effective in buffer than in TH or NB. This inactivation was mainly due to the loss of the ability of the phage to absorb. No mutations were induced by the indirect effect (via free radicals) of x irradiation. Chemically produced radicals (sulfite reaction) inactivated the phage but were not mutagenic. X irradiation in TH at pH 3 induced fewer c and b mutations than at pH 7, but the e mutations were probably induced more effectively. Irradiation in NB at pH 3 induced more c and b type than at pH 7, but the e type was not markedly induced at either pH value. Thus, the mutagenic mechanisms with x rays vary with pH as well as with the kind of protecting substance. It is suggested that x-ray-induced premutations may be in the form (partially) of thyminehydroperoxide, but other chemical products in the DNA must also be responsible for the mutagenicity of x rays, and their relative importance varies with the mutation type. (BBB)

22819 CIRCULAR DNA FORMATION BY LAMBDA MUTANTS. Salzman, Lois A.; Weissbach, Arthur (National Inst. of Arthritis and Metabolic Diseases, Bethesda, Md.). Virology, 30: 579-81(Nov. 1966).

Lysogenic induction of Escherichia coli K12(λ) bacteriophage results in the production of a new, fast-sedimenting form of DNA with the characteristics of a twisted, circular λ DNA. The formation of this circular λ DNA by the suppressor-sensitive, conditional lethal λ sus mutants is described. The phage mutants were examined for their ability to produce circular λ DNA either after infection of the nonpermissive, suppressor-negative nonlysogenic host, E. coli W3350(S), or after lysogenic induction of the appropriate W3550 lysogen. Each W3350 lysogen culture was induced with uv light and methyl-^{3}H-thymidine was added. After incubation the DNA was isolated by sucrose gradient sedimentation. After uv light induction of W3350 sus Q_{11}, there were 2 DNA peaks, the 2nd of which was circular DNA. In contrast, only one peak, the slow-moving, linear DNA was present 45 min after uv induction of W3350 sus N_7. The fast-sedimenting circular DNA was also absent after uv induction of early sus mutants O_8 and P_3. Control experiments in which nonlysogenic W3350(S) was exposed to uv light and the DNA was isolated, as above, also failed to reveal any fast-sedimenting DNA species. Thus, lysogens defective in the early cistrons N, O, and P are unable to generate any newly synthesized circular λ DNA molecules after induction, while those lysogens tested which are defective in the cistrons controlling late phage functions synthesize the circular λ DNA. (BBB)

22820 CONTINUOUS RESPIRATION MEASUREMENTS IN AZOTOBACTER CHROOCOCCUM BEIJ IN MONTMORILLONITE DURING CHRONIC X IRRADIATION. Mueller, Hermann P.; Schmidt, Lothar (Kernforschungsanlage, Juelich, Ger.). Arch. Mikrobiol., 54: 70-9(1966). (In German).

Azotobacter chroococcum maintained in a montmorillonite nutrient system was irradiated at a rate of 100 R/min with 100-kV x rays at a temperature of 24°C for various periods up to 16 hr. The CO_2 production was depressed. In one strain the depression increased steadily from 3.6% at 3 hr to 80.4% at 16 hr of irradiation. In a second strain respiration was decreased by 7.2% at 2 hr and by 46.4% after 8 hr. The degree of respiration appeared to be a direct function of the number of surviving bacteria. However, compared to irradiated bacteria in control nutrients, both Azotobacter strains appeared to be more radioresistant when grown on montmorillonite systems. (BBB)

22821 STUDIES ON THE MECHANISM OF THE LETHAL ACTION OF X RAYS ON ESCHERICHIA COLI K12 BY MEANS OF GENETIC RECOMBINATION. Marcovich, H. (Institut Pasteur, Paris). Ann. Inst. Pasteur, 101: 660-76(Nov. 1961). (In French).

The effects of x irradiation on the genetic recombination of E. coli K12 HfrH were studied. Irradiation diminished the transfer of the selected markers according to an exponential dose effect relation. The radiosensitivity of the transfer process for a given marker was directly related to its distance to the origin O of the chromosome. The transfer of the nonselected markers was not altered if they were located between the origin O and the selected markers. The transfer of the markers located on the part of the chromosome opposite to the origin O was, on the contrary, diminished according to their distance to the selected marker. The sensitivity of the chromosome seemed to be homogeneous in this respect. No other alteration of the genetic material was detected. It was not possible to link the lethal effect of x rays in E. coli K12 to a dominant lethal mutation transmissible to the zygote by recombination. Most of the HfrH cells which survived to high doses (10^{-5} survivors) were normal as regards mating ability and sequence of the markers: some low frequency recombination mutants were isolated. F^- cells irradiated with x rays were restorable by mating with irradiated or nonirradiated HfrH cells. Glycerol reduced by the same amount the radiosensitivity of both the transfer of the markers and the viability of the cells. (BBB)

22822 LETHAL EFFECT OF GAMMA IRRADIATION ON EUGLENA CELLS IN TWO DIFFERENT GROWTH PHASES. Matsuoka, Saburo (Gifu Univ., Japan). Bull. Inst. Chem. Res., Kyoto Univ., 45: 12-20(Jan. 1967).

Growth response and lethal effect of Euglena cells exposed to 1×10^5 R gamma rays were investigated in two different growth phases, logarithmic and stationary. The logarithmic phase cells showed characteristic features different from the stationary phase cells in the following five points: first, the irradiated logarithmic phase cells had a lower death rate than the irradiated stationary phase cells; second, the former cells showed more rapid growth recovery than the latter ones; third, the former cells were fewer in sluggish cell number than the latter ones; fourth, the former cells were smaller in degree of swelling than the latter ones; and fifth, the former cells had less water content than the latter ones. The dry weight of all the cells used was hardly affected by irradiation and remained almost unchanged during the incubation period after irradiation. (auth)

22823 EFFECT OF GAMMA IRRADIATION ON URACIL-^{14}C INCORPORATION INTO EUGLENA CELLS. Matsuoka, Saburo (Gifu Univ., Japan). Bull. Inst. Chem. Res., Kyoto Univ., 45: 21-9(Jan. 1967).

Radiosensitivity of various kinds of RNA in Euglena cells of two different growth phases, logarithmic and stationary, to 1×10^5 R gamma irradiation was investigated by labeling these RNAs with uracil-^{14}C and fractionating them chromatographically. The raw nucleic acid of the logarithmic phase cells decreased more in quantity than that of the stationary phase cells after the irradiation. When this raw nucleic acid was fractionated by MAK column chromatography, all the fractions of irradiated cells obtained decreased in uv absorbency compared with non-irradiated cells. The decrease in uv absorbency of all the fractions became low in the order of eluting sequence, A, B, C, and D in the irradiated logarithmic phase cells, and in the order B, A, C, and D in the irradiated stationary phase cells. Although the RNA level was affected by irradiation, a slight uracil-^{14}C incorporation into RNA was recognized in the irradiated logarithmic phase cells, while uracil-^{14}C incorporation into RNA was hardly recognized in the irradiated stationary phase cells. (auth)

22824 EFFECTS OF GAMMA IRRADIATION ON THE PROTEIN CONTENT OF EUGLENA CELLS AND ON THE ALANINE-^{14}C INCORPORATION INTO THE CELLS. Matsuoka, Saburo (Gifu Univ., Japan). Bull. Inst. Chem. Res., Kyoto Univ., 45: 30-42(Jan. 1967).

Effects of 1×10^5 R gamma irradiation on the protein content and alanine-^{14}C incorporation into cell protein were compared between Euglena cells in two different growth phases, logarithmic and stationary. The following irradiation effects were common to these two growth phase cells: first, the soluble protein content per cell of the irradiated cells was slightly larger than that of the nonirradiated cells, but it remained almost constant during the incubation period; second, the nonextractive protein content per cell of the nonirradiated cells increased according to incubation time, but that of the irradiated cells remained unchanged during the same incubation period after irradiation; third, the nucleoprotein in fraction C separated through a Sephadex column was more unstable to gamma rays than the other soluble proteins; fourth, the incorporation of alanine-^{14}C into the irradiated cells was markedly inhibited by irradiation. The logarithmic phase cells were more susceptible to radiation in all

cases than the stationary phase cells. Although alanine-^{14}C incorporation into protein was recognized slightly in the case of irradiated logarithmic phase cells, but it was hardly recognized in the case of irradiated stationary phase cells. (auth)

22825 EFFECT OF ETHYLENIMINE, ULTRAVIOLET LIGHT, OR THEIR COMBINATIONS ON VARIATION OF ACT AUREOFACIENS WITH RESPECT TO SYNTHESIS OF CHLORTETRACYCLINE AND VITAMIN B_{12}. Romanova, N. B.; Alikhanyan, S. I. (All-Union Scientific-Research Inst. of Antibiotics, Moscow). Antibiotiki, 11: 984-7(Nov. 1966). (In Russian).

The effect of ethylenimine, ultraviolet light, or combinations of these factors on variation of A aureofaciens was studied. It was shown that treatment with ethylenimine followed by ultraviolet irradiation resulted in a synergistic effect with respect to the spore survival in case the dose of ethylenimine was low, while that of ultraviolet light was rather high. Still the use of a high ethylenimine dose in combination with a low dose of ultraviolet light produced a survival effect close to an additive one. The use of combined treatment did not increase the frequency of correlation in high activities with respect to the antibiotic and vitamin production. With respect to the both properties the number of plus variants obtained after combined treatment was lower than the theoretical one. The combined treatment, as well as the treatment with the mutagenic factors taken separately proved to be more significant for the property of vitamin production than for the property of antibiotic production. (auth)

22826 COMMENT ON THE RELATIONSHIP BETWEEN UV REACTIVATION AND HOST-CELL REACTIVATION IN PHAGE. Harm, Walter (Southwest Center for Advanced Studies, Dallas). Virology, 29: 494(July 1966).

Results are reported from studies of mechanisms involved in the uv reactivation of phage λ on bacteria. (TSS)

22827 EFFECT OF ETHYLENIMINE, ULTRAVIOLET LIGHT AND THEIR COMBINATIONS ON ACT. FLORIDAE, STRAIN 4034 PRODUCING FLORIMYCIN. Romanova, N. B. (All-Union Scientific-Research Inst. of Antibiotics, Moscow). Antibiotiki, 12: 114-18(Feb. 1967). (In Russian).

Data on the effect of various doses of ethylenimine, ultraviolet light and their combinations upon survival of spores, morphological variation, variation with respect to antibiotic production, frequency of plus and minus variants in Act. floridae, 4034 producing florimycin are presented. (auth)

22828 MIGRATORY BEHAVIOR OF X-IRRADIATED AND NONIRRADIATED LARVAE OF ASCARIS SUUM IN PIGS. Ferguson, Donald Leon. Lincoln, Neb., Univ. of Nebraska, 1966. 142p.

Thesis.

Studies were undertaken to investigate the migratory behavior of X-irradiated and nonirradiated larvae of A. suum in pigs, and to develop, if possible, a technique of vaccinating pigs against infections of A. suum using a vaccine in which infective larvae had been partially inactivated by treatment with X ray. Administration of 50,000 nonirradiated infective eggs to 15 eight to 12-week-old pigs caused severe signs of ascariasis in pigs and death of three pigs nine to ten days postinfection. A dose of 50,000 X-irradiated eggs of A. suum to 11 similar age pigs produced only a slight increase in rate of respiration in eight animals. Eight pigs were given 50,000 nonirradiated eggs and 21 days later challenged with a dose of 50,000 or 200,000 nonirradiated eggs. The animals developed severe clinical signs of ascariasis and two died, thus indicating little resistance. When pigs were given 50,000 X-irradiated eggs and 21 days later challenged with a dose of 50,000 or 200,000 nonirradiated eggs, only a slight increase in rate of respiration developed in three pigs, thus indicating resistance to infection. These studies have indicated that the gross and microscopic lesions observed in swine infected with migrating larvae of A. suum apparently result from a sensitization of the supporting tissues in the liver, whereas earlier literature reports these changes attributable to the mechanical migration of the larvae. (Dissertation Abstr.)

Radiosterilization and Radiopreservation

Refer also to abstract 22806.

22829 (AECD-RB-2) SURVEY AND RADIO-STERILIZATION DOSES OF FUNGI CAUSING SPOILAGE OF RICE IN STORAGE. Chowdhury, S. U.; Hossain, M. M.; Yusuf, Q. M. (Atomic Energy Centre, Dacca (Pakistan). Radiobiology Div.). May 1966. 36p. Dep. mn.

Six different species of fungi were found to be responsible for the spoilage of stored rice. These included Mucor fragilis, Aspergillus ochraceous, A. ustus, A. tamarii, A. versicolor, and Rhizophus oryzae. Gamma radiation, from a ^{60}Co source, at doses of 192 to 225 Kr sterilized the rice, while doses of 170 to 185 Kr inactivated the fungi and prevented spoilage of stored rice. (C.H.)

22830 (PRNC-95) RADIATION-INDUCED STERILITY FOR POPULATION CONTROL OF THE SUGARCANE BORER (DIATRAEA SACCHARALIS) IN PUERTO RICO. Technical Report No. 2. Walker, David W. (Puerto Rico Nuclear Center, Mayaguez). May 1966. Contract AT(40-1)-1833. 47p. Dep. mn. CFSTI $3.00 cy, $0.65 mn.

Progress is reported on studies concerned with radioinduced sterility of the sugarcane borer, Diatraea saccharalis for population control. Research problems on development of a more efficient rearing medium; effects of yearly seasons on the life span of the cane borer; egg productivity and mating behavior of radiosterilized insects; γ radiation dosimetric measurements; rate of larval growth and maturation during different seasons; seasonal population fluctuations; and stages of egg maturation are outlined and discussed. It was established that only adult stages of this species could be sterilized with γ radiation without mortality and that radiosterilized females and males were as competitive in mating as normal adults. (B.H.S.)

22831 (JPRS-40119) NEW TECHNOLOGICAL METHODS IN PROCESSING MEAT PRODUCTS. Sokolov, A. A. Translated from pp 432-42; 488-90 of Fiziko-Khimicheskie i Biokhimicheskie Osnovy Tekhnologii Myasoproduktov, Food Industry Publishing House, Moscow, 1965. 24p. (TT-67-30765). CFSTI $3.00 cy, $0.65 mn.

A translation of the table of contents and a chapter on radiation processing of meat is presented. The chapter includes discussions of various types of ionizing radiation, effects of irradiation on the component parts of meat products, effects on microorganisms, and irradiation of meat products. (H.L.W.)

22832 THYROIDITIS IN A GROUP OF LABORATORY DOGS: A STUDY OF 167 BEAGLES. Tucker, Walter E. Jr. (Armed Forces Inst. of Pathology, Washington, D. C.). Amer. J. Clin. Pathol., 38: 70-4(July 1962).

During routine histologic examination of tissues from a group of beagle dogs used in a long-term study of irradiated foods, many animals, including controls, were noted to have inflammatory changes in the thyroid glands. Irradiated foods had been fed to the extent of 20 to 35% of the diet by dry weight for 2 yr. Neither clinical signs attributable to thyroid dysfunction nor gross lesions of the thyroid gland were found. Upon histological examination, however, 27 (16.2%) dogs of a total of 167 had lesions of the thyroid gland that were interpreted as inflammatory. Causative factors considered included infectious agents, nutritional factors, aging, trauma, endocrine imbalance, and autoimmunity. Although some of these factors seem unlikely, they cannot be entirely dismissed. The ingestion of irradiated foods was probably not responsible, inasmuch as thyroiditis occurred with equal incidence and severity in both the control dogs fed nonirradiated foods and in dogs fed the irradiated foods. (TSS)

22833 EFFECTS OF IONIZING RADIATION ON PHARMACEUTICALS. Wills, Pamela A. (Australian Atomic Energy Research Establishment, Lucas Heights). Austral. J. Pharm., 44: S50-7(May 30, 1963).

Use of radiation to sterilize drug preparations is considered and the literature is reviewed relating to the effects of radiation on the following: vitamins, steroids, hormones, alkaloids, antigens, antibiotics, carbohydrates, and enzymes. Few data have appeared in the literature dealing specifically with the actual degradation products of the pharmaceuticals which do not withstand radiation treatment, so this survey is mainly confined to indicating which products may or may not be successfully radiosterilized. The fact that little work has been carried out on the identification of the degradation products formed from radiation-sensitive materials prevents understanding of the reactions concerned, so that additives can be introduced to combat these deleterious effects. A discussion is provided on the 2 ways in which radiation by direct action can be obtained: when the molecule undergoing change is itself ionized or excited by the passage of an electron and by indirect action, when it receives energy by transfer from some other molecule. Direct action can occur when substances are irradiated in the pure dry state; in aqueous solutions or living tissue, action may be direct or indirect. When dilute aqueous solutions are irradiated, indirect action occurs. The indirect effects of radiation m may be modified, for example, by the use of very pure water, or by freezing, which prevents the diffusion of the reactive compo-

nents. Both direct and indirect action may be altered by the presence of oxygen or the addition of certain other solutes which may provide protection by competing for the free radicals and activated molecules. Molecules which possess resonance and can absorb a considerable amount of energy before excitation occurs may exert a protective effect when combined with more sensitive compounds. This review reveals that ionizing radiation is not useful for sterilization of all pharmaceutical products. Rather, each individual product must be examined insofar as sterility, dose requirements, reactions of the product in its various physical forms, effects of pH, effects of the packaging material on these reactions, possible toxic manifestations, and clinical testing are concerned. (BBB)

22834 INVESTIGATIONS ON THE STERILIZATION OF CULTURE SOILS. Ernst, D.; Glubrecht, H. (Technische Hochschule, Hanover). pp 163-7 of Biophysikalische Probleme der Strahlenwirkung. Muth, H. Stuttgart, Georg Thieme Verlag, 1966. (In German).

The question of whether bacteria and fungi or earth enzymes are responsible for the lime nitrogen (calcium cyanamide) transformation processes in soil or whether the process is a purely inorganic reaction was investigated using radiosterilization. The sterilization and dosimetric techniques used are outlined. The results showed that colony formation after radiosterilization of the soil decreases exponentially with the radiation dose. The results further indicated that 50 to 80% of the calcium cyanamide transformation is caused by bacteria and the rest is caused by earth enzymes. Sterilization with steam or ethylene oxide brings this transformation reaction almost completely to a stop. (J.S.R.)

22835 MUTAGENIC ACTIVITY OF IRRADIATED FOOD CONSTITUENTS. Khan, A. H. (Cambridge Univ., Eng.). Nucleus (Lahore), 3: No. 1-2, 30-1(Jan.-June 1966).

Experiments designed to detect a mutagenic effect of DNA towards Drosophila larvae after the DNA was exposed to a heavy dose of ionizing radiation prior to its addition to a chemically-defined and axenic Drosophila medium are described. Although non-irradiated DNA is found to be mutagenic under these conditions, the prior irradiation of the DNA does not change the mutagenic effectiveness of the DNA compared with the non-irradiated DNA sample. (auth)

22836 DETERMINATION OF AROMA COMPOUNDS AS AN INDEX OF PEAR MATURITY. Heinz, D. E.; Creveling, R. K.; Jennings, W. G. (Univ. of California, Davis). J. Food Sci., 30: 641-3(July-Aug. 1965).

The effects of ripening and ionizing irradiation on some flavor esters of Bartlett pears were examined. The production of esters of trans: 2-cis: 4-decadienoic acid, identified as contributory flavor compounds of the pear, was shown to increase rapidly at the climacteric, and continue to increase as ethylene and CO_2 production declined. The production of the decadienoates was readily followed by uv spectrophotometry, and their measurement offered a simple and convenient criterion of fruit maturity that is a direct function of fruit flavor. Irradiation of pears, which produced flavorless and subnormal fruit, also severely inhibited the production of the decadienoates. Thus, after a 12-day ripening period, pears irradiated with 300,000 rads γ radiation from a ^{60}Co source possessed only $\frac{1}{30}$ the 2,4-decadienoate esters of control pears that had not been irradiated. It was evident that irradiation influenced the ripening process, for the irradiated pears were noticeably greener, firmer, and less desirable than the control pears. (BBB)

METALS, CERAMICS, AND OTHER MATERIALS

Metals and Alloys

Refer also to abstracts 21928 and 23589.

Corrosion and Erosion

Refer also to abstracts 22872 and 22894.

22837 (BAW-3765-1) CORROSION AND HYDRIDING OF ZIRCALOY. Quarterly Technical Progress Report No. 1, September 15–December 31, 1966. (Babcock and Wilcox Co., Lynchburg, Va. Research and Development Div.). Feb. 1967. Contract AT(30-1)-3765. 42p. (EURAEC-1319). DTIE.

Work Performed under United States–Euratom Joint Research and Development Program.

Developments are reported for studies on corrosion and hydriding of Zircaloy under heat transfer conditions, and determination of effects of hydrogen and hydride distribution on mechanical properties of Zircaloy. (P.C.H.)

22838 (BNL-50007) MONEL AND NICKEL CORROSION IN NONAQUEOUS NO_2–HF SOLUTIONS. Kigoshi, Akiichi; Strickland, Gerald (Brookhaven National Lab., Upton, N. Y.). Aug. 1966. Contract AT(30-2)-Gen-16. 12p. Dep. mn. CFSTI $3.00 cy, $0.65 mn.

The corrosion rates of Monel alloy 400 and Nickel 200 were studied in several NO_2–HF solutions that seem promising for use in reprocessing nuclear reactor fuels. Special probes fabricated of Monel or Ni wire were immersed in solutions containing up to 30 mole % NO_2 and heated in the range 25 to 150°C. The progress of surface corrosion was followed by measuring the change in electrical resistance of the wire probes. In general, Ni was superior to Monel. Increasing concentrations of NO_2 were used, and the first detectable corrosion of Monel occurred in 20 mole % NO_2–80 mole % HF solution at 150°C. For Ni the conditions were 25 mole % NO_2 and 125°C. In solutions containing 25 and 30 mole % NO_2, the high initial corrosion rate of Monel gradually decreased to a very low value because of formation of a protective film. This film was strong enough to endure large changes in concentration or temperature. Moisture had a severe effect on vapor phase corrosion of both Monel and Ni. Dissolved UO_2 or the presence of H_2O increased corrosion in the liquid phase. The effect of stress on surface corrosion was insignificant in the elastic range, but in the plastic range it greatly increased both the initial corrosion rate and total corrosion during film formation. It was concluded that both Monel and Ni are satisfactory materials of construction. (auth)

22839 (BNWL-SA-1137) CORROSION OF SUPERALLOYS AND REFRACTORY METALS IN HIGH TEMPERATURE FLOWING HELIUM. Charlot, L. A.; Thiede, R. A.; Westerman, R. E. (Battelle-Northwest, Richland, Wash. Pacific Northwest Lab.). Mar. 1967. Contract AT(45-1)-1830. 28p. Dep. mn. CFSTI $3.00 cy, $0.65 mn.

The oxidation and evaporation behavior of Haynes 25 and Hastelloy X was determined under flowing He conditions in two high temperature loop systems at temperatures to 2100°F, linear flow velocities to 500 fps, and a pressure of 300 psi. Oxidation rates of the superalloys did not appear to be affected by the presence of high-velocity He. Evaporation rates increased with gas flow rate and temperature, and decreased with inert gas overpressure. Refractory metal samples were exposed along with superalloy samples in the larger loop at 2100°F, 300 psi. It was found that clean loop conditions, with multiple start-ups after permitting access of air to the loop system, led to evaporative weight loss of the superalloys, contamination and weight gain of the Nb and Ta samples, and no significant evidence of attack on the Mo and W samples. (auth)

22840 (N-67-13181) CAVITATION DAMAGE IN LIQUID METALS (POTASSIUM STUDIES). Technical Progress Report, January 10–July 31, 1966. Preiser, H. S.; Rudy, S. L. (Hydronautics, Inc., Laurel, Md.). Sept. 29, 1966. Contract NAS3-8506. 39p. (NASA-CR-72088; TPR-607-1). CFSTI $3.00 cy, $0.65 mn.

The existing dry box facility was modified and calibrated for conducting high-temperature liquid-potassium cavitation damage tests. O_2 and moisture in the Ar-cover gas in the dry box can be maintained below 5 ppm for 1 hour with the glove ports closed. An 8-hour K purity test under operating conditions was made and oxide impurity levels were maintained well below 50 ppm. Instrumentation for monitoring amplitude of the magnetostriction device was installed in the air-cooled free end of the transducer, away from contact with liquid metal vapor. A program for cavitation damage tests under various temperature and pressure parameters is in progress. The materials selected are TZC, T-111, TiC, and Cb-132M. (auth)

22841 (ORNL-4076, pp 55-79) AQUEOUS REACTORS. (Oak Ridge National Lab., Tenn.).

Research is reported on: corrosion and chemical behavior in reactor environments, chemistry of high-temperature aqueous solutions, and interaction of water with particulate solids. (M.C.G.)

22842 (AI-Trans-233) INVESTIGATION OF SEVERAL FERRITIC STEELS FOR HIGH TEMPERATURE SERVICE AND THEIR APPLICABILITY IN SODIUM SYSTEMS UP TO TEMPERATURES OF ABOUT 600°C. Motz, Juergen. Translated for Atomics International, Canoga Park, Calif., from Z. Metallk., 55: 489-94(1964). 11p. Dep. mn. CFSTI $3.00 cy, $0.65 mn. JCL $1.60 fs, $0.80 mf.

Studies were made on austenitic and ferritic steels (Cr–Ni–Nb, Cr–Ti–Ni, Cr–Mo, Cr–Mo–V, and Cr–Mo–Nb) for high temperature service in respect to their suitability for commercial Na systems up to 600°C. The results showed that the ferritic steel 10CrMoNb9 was hardly attacked at all by industrially cleaned (purified) Na and that because of the Nb content the C transport to the austenitic steels through activity equilization was prevented up to temperatures of 600°C. (P.C.H.)

22843 RATE-CONTROLLING PROCESSES IN THE HIGH-TEMPERATURE OXIDATION OF TANTALUM. Stringer, John (Battelle Memorial Inst., Columbus, Ohio). J. Electrochem. Soc., 114: 428-35(May 1967).

The oxidation of Ta was studied in the temperature range from 500 to 950°C. At atmospheric pressure, the rate constant increased with temperature in the temperature range from 500 to 650 and 800 to 950°C, but decreased slightly as the temperature increased from 650 to 800°C. The reaction rate depended on the square root of the oxygen pressure at low pressures and high temperatures, but at lower temperatures the pressure dependence decreased as the pressure increased. It was concluded that in the temperature range 500 to 800°C the rate-controlling process is a reaction at the interface between the atmosphere and a layer of Ta_2O_5 growing adherently on the metal surface. This interface reaction is preceded by an equilibrium adsorption of O_2 on the interface, the adsorption taking place with dissociation. In the temperature range 800 to 950°C, the over-all linear rate is a consequence of the diffusion-controlled growth of adherent pentoxide to a critical thickness, at which the scale falls from the metal. The corollary to this conclusion is that the rate of the diffusion process must be strongly dependent on the O_2 pressure. (auth)

22844 KINETICS OF TANTALUM CORROSION IN AQUEOUS ELECTROLYTES. II. Lehovec, K.; D'Amico, John (Sprague Electric Co., North Adams, Mass.). J. Electrochem. Soc., 114: 495-504(May 1967).

Transients of the voltage between a Ta foil and an aqueous electrolyte were induced by application of dc current or ac voltage steps during the growth of a thin protective oxide film. These transients were analyzed in terms of the dependences on voltage and oxide thickness of the ionic current causing the oxide growth and the current required for charge neutralization. Certain discrepancies between the theoretical model used to analyze the transients and the experimental data indicate a more complex behavior of the oxide than that of an ideal capacitor shunted by a voltage-dependent resistor responding instantaneously to changes in the voltage. (auth)

22845 LIQUID SODIUM TECHNOLOGY DEVELOPMENT. I. TEST LOOPS, PURIFICATION METHODS, AND CORROSION TESTS. Furukawa, Kazuo; Yamamoto, Ken; Nihei, Isao; Iguchi, Yae (Japan Atomic Energy Research Inst., Tokyo). J. Nucl. Sci. Technol. (Tokyo), 3: 501-15(Dec. 1966).

General results obtained from an initial program for developing liquid Na loop technology and related techniques are reported. The loop systems are outlined, together with operating experiences on three types of test loops, i.e., for studies in corrosion and in purification and for a system of mother and daughter loops. A description is given of results obtained on the purification system (cold trap, hot trap, etc.) work undertaken on the loop Na and on the adopted standard operational procedure. Preliminary results of the corrosion test and carburization test are reported. The main objective of the present experiment was to test austenitic stainless steels, but supplementary work was also done with Cr–Mo steels and refractory metals, Nb, Ta, Mo, Zr, and Ti. Also reported are the methods adopted for analyzing the data, the behavior ob-

served on O_2, C, and other impurities in Na, and work in developing an impurity meter (plugging indicator). (auth)

22846 MOLYBDENUM AND BM-1 ALLOY CORROSION IN MOLTEN FLUORIDES. Blinova, V. A.; Ozeryanaya, I. N.; Belyaeva, G. I.; Konstantinova, E. V. Tr. Inst. Elektrokhim., Akad. Nauk SSSR, Ural. Filial, No. 9, 109-16(1966). (In Russian).

Corrosion tests of Mo and BM-1 in fused pure LiF and a mixture of 10 wt % LiF and 90 wt % CaF_2 in an Ar atmosphere at 1250 to 1350°C showed that in fluoride melts Mo and BM-1 (Zr–Ti–C–Cr alloy) disintegrate without forming solid corrosion products. The contact with fused fluorides containing Li ions with graphite produced MoC which did not dissolve in fluoride melts. (R.V.J.)

Preparation and Fabrication

Refer also to abstracts 21862 and 22882.

22847 (AD-635755) INVESTMENT CASTING OF MAGNESIUM–LITHIUM ALLOYS. Saia, Anthony; Edelman, Ralph E. (Frankford Arsenal, Philadelphia, Pa. Pitman-Dunn Research Labs.). June 1966. 15p. (M-66-25-1). CFSTI $3.00 cy, $0.65 mn.

A method was developed for investment casting Mg–Li alloys into inhibited gypsum-bonded molds. Both prototype castings and separately cast test bars (0.252 inch) were produced. Visual and metallographic examination showed no evidence of metal–mold reaction. Tensile property data were obtained on two previously developed alloys, Mg–14Li–0.5Si and Mg–14Li–5Zn–3Ag–2Si. The strength level and the ductility of the investment-cast test bars were found to correspond with previously measured properties obtained on bars cast into a permanent steel mold (0.505 inch). (auth)

22848 (NLCO-990) ROLLING STUDIES OF URANIUM RODS AND TUBES. Hesselbrock, H. W. (National Lead Co. of Ohio, Cincinnati). Apr. 1967. Contract AT(30-1)-1156. 35p. Dep. mn. CFSTI $3.00 cy, $0.65 mn.

U billets, both hollow and solid, were rolled on a 16 by 24-in. two-high mill. Three types of U were studied: unalloyed metal; metal with 100 to 150 ppM Fe and Si; and metal with 350 ppM Fe, 350 ppM Si, and 800 ppM Al. Roll separating forces, dimensional changes, and grain structures were evaluated for varying amounts of working. The change in wall thickness during rolling was ascertained for billets of varying T/D ratios (initial wall thickness to diameter). Wall thicknesses ranging from 10% of the OD to a solid bar were explored. The ratio of the separation forces of rods to tubes was determined. (auth)

22849 (NUMEC-3731-4,5-4) RADIOISOTOPE POWERED CARDIAC PACEMAKER PROJECT. TECHNICAL MEMORANDUM. PLATINUM PLATING ON COMPONENT PARTS. Recchia, Andrew (Nuclear Materials and Equipment Corp., Apollo, Pa.). Mar. 6, 1967. Contract AT(30-1)-3731. 15p. Dep. mn. CFSTI $3.00 cy, $0.65 mn.

Plating parameters have been established for depositing an adherent electroplate of Pt directly on Hastelloy C capsules. As an alternate procedure, a Ni flash electroplate was deposited prior to the Pt electroplate. The experimental hardness value of the Pt electroplate was compared with the hardness of the Pt anode material. A post plating treatment at 200°C was necessary to expel entrapped gases and moisture in the electroplate. Cross sectional examination indicated that a good mechanical bond exists between the Pt electroplate and Hastelloy C. For complete encapsulation of Hastelloy C with Pt, the established plating parameters were extended to barrel plating, which produced good bonding in the as-plated condition and in the 200°C heat treatment. However, thermal shock testing produced micro-blisters, which indicated spotty bonding of the electroplate to Hastelloy C. (P.C.H.)

22850 (SC-M-67-230) SOFT SOLDERING. (Sandia Corp., Albuquerque, N. Mex.). July 1965. Contract AT(29-1)-789. 56p. Dep. mn. CFSTI $3.00 cy, $0.65 mn.

A compilation of information on soft soldering as it applies to electrical components and assembly is presented. The data contained should be beneficial as an aid to solving soldering problems. (auth)

22851 (WAPD-T-1965) THEORY OF THE SINTERING OF WIRES BY SURFACE DIFFUSION. Nichols, F. A. (Bettis Atomic Power Lab., Pittsburgh, Pa.). Jan. 1967. Contract AT(11-1)-Gen-14. 35p. (CONF-670206-2). Dep. mn. CFSTI $3.00 cy, $0.65 mn.

From 96th Annual Meeting of the American Institute of Mining, Metallurgical, and Petroleum Engineers, Los Angeles, Calif.

A convergent, stable, finite-difference solution has been developed for the case of two-dimensional shape changes due to capillarity-induced surface diffusion and applied specifically to the cases of an infinite line of wires and a wire on a plane. The solution for the wire on a plane shows significant deviation from the earlier, order-of-magnitude solution for a sphere on a plane. The solution for an infinite line of wires was obtained for the first time. Both cases show that a time "law" is only approximately obeyed in a restricted range of neck sizes and if the conventional formula $x/a \sim t^{1/n}$ is employed, where x = neck radius, a = wire radius and t = time, it was found that for the range of most experimental data n varies from ~5.2 to ~6.5 with an average value of ~6, rather than the fixed value of 7 predicted previously. This, coupled with other indications, led to the conclusion that surface diffusion has been the dominant mechanism in all wire-sintering experiments to date and some of the data have been re-evaluated on this basis. The solution also provides a quantitative theoretical basis for the actual neck shapes evolved, shows them to be in agreement with the previous predictions of Mullins and in substantial disagreement with the shapes assumed in the previous order-of-magnitude treatments. (auth)

22852 (AEC-tr-6854) WELDING PROBLEMS ON THE CZECHOSLOVAK REACTOR PRESSURE VESSEL. Becka, Josef (SKODA Works, Pilsen (Czechoslovakia)). Translated by U. E. Wolff (General Electric Co., San Jose, Calif.), from a report. 14p. Dep. mn. CFSTI $3.00 cy, $0.65 mn. JCL $1.60 fs, $0.80 mf.

Several welding procedures were tried experimentally on the shortened pressure vessel model, scale 1 : 1: circumferential manual arc welding; semiautomatic CO_2 inert gas welding; automatic UP welding; and electro slag welding. The results confirmed the suitability of the welding concepts with broad application of electro slag welding. The welds made by electro slag welding and manual arc welding, after suitable heat treatment, can be assigned a welding coefficient of 1. Mechanical properties, neutron stability, and occurrence of flaws conform with the technical requirements. (P.C.H.)

22853 (AEC-tr-6856) SOLUTION TO SOME TECHNOLOGICAL ASPECTS DURING FABRICATION OF THE PRESSURE VESSEL OF THE FIRST CZECHOSLOVAK NUCLEAR POWER PLANT. Filip, Radislav; Indra, Jaroslav (SKODA Works, Pilsen (Czechoslovakia)). Translated by U. E. Wolff (General Electric Co., San Jose, Calif., from a report. 17p. Dep. mn. CFSTI $3.00 cy, $0.65 mn. JCL $1.60 fs, $0.80 mf.

Brief descriptions are given of the technological processes that were developed and used for fabrication of the most highly stressed parts of the first Czechoslovakia nuclear power reactor pressure vessel. These parts include the flanges, nozzle rings, and the spherical caps of cover and bottom. (P.C.H.)

22854 DEPOSITION OF TANTALUM AND TANTALUM OXIDE BY SUPERIMPOSED RF AND DC SPUTTERING. Vratny, F. (Bell Telephone Labs., Inc., Murray Hill, N. J.). J. Electrochem. Soc., 114: 505-8(May 1967).

The advantages and flexibility of glow discharge diode sputtering for the deposition of thin films can be greatly extended by the simultaneous application of a dc and rf field at the cathode. The combined field increases the plasma density and prevents the formation of a dielectric film on the cathode during reactive sputtering. This technique allows: operation at sputtering pressures of 0.5 to 2.0 millitorr with a Ta deposition rate of ~80 Å/min, or a two-fold increase in Ta deposition rate for pressures in the 10 to 20 millitorr range; and high deposition rates (50 to 100 Å/min) for the deposition of Ta_2O_5 and MnO_x by reactive sputtering in pure O_2. (auth)

22855 VAPOR PHASE FORMING. McKnight, Herman G. (Refractory Metal Products, Inc., Santa Fe Springs, Calif.). Mech. Eng., 89: No. 2, 42-5(Feb. 1967).

The vapor phase deposition process for the production of hardware is discussed, and its advantages are given. W, which is difficult to fashion into thin sheets and high density coatings without the use of vapor deposition, is given as an example. In the deposition of W, the hydrogen reduction of WF_6 is generally used. The tailoring of new composite materials is also discussed. (P.C.H.)

22856 A "BOOMLET" IN ZIRCALOY. Jeffery, Grant. Nucleonics, 25: No. 3, 66-70(Mar. 1967).

The economic and production factors of Zircaloy fuel cladding are discussed from the viewpoint of projected requirements to 1978. Characteristics and applications of seven alternate metallic cladding materials are tabulated and physical properties required of cladding materials are itemized. (P.G.C.)

Properties Evaluations

Refer also to abstracts 21862, 21922, 22837, 22842, and 22847.

22857 (AERE-R-5352) A TRANSPIRATION APPARATUS FOR MEASURING VAPOUR PRESSURES: THE VAPOUR PRESSURE OF GOLD. Phillips, B. A.; Rand, M. H. (Atomic Energy Research Establishment, Harwell (England)). Feb. 1967. 24p. Dep. mn. CFSTI $3.00 cy, $0.65 mn. HMSO 3s. 6d.

An apparatus is described for the measurement of vapor pressures of Pu compounds by the transpiration technique. A measured volume of He is passed over the inductively-heated sample, whole weight loss is determined. The vapor pressure of liquid Au, which has been measured in this apparatus, is given by the equation log p(atm) = 5.840 − 18,009/T over the temperature range 1723 to 2142°K. The results give a value of $87.94 \pm 0.3_3$ kcal for the heat of sublimation of Au (to monatomic vapor) at 25°C. (auth)

22858 (AWRE-O-2/67) HYDROGEN IN BERYLLIUM. Jones, P. M. S.; Gibson, R. (Atomic Weapons Research Establishment, Aldermaston (England)). Feb. 1967. 27p. Dep. mn. CFSTI $3.00 cy, $0.65 mn. HMSO 3s. 9d.

Tritium was used to study the solubility and diffusion of H_2 in arc-cast Be. Values of D and S are given by: $\log_{10} D\ cm^2\ s^{-1} = -(6.53 \pm 0.15) - (965 \pm 106)/T°K$ and $\log_{10} S$ (std ml/g $atm^{\frac{1}{2}}$) = $-(2.12 \pm 0.27) + (0.095 \pm 0.211)/T°K$. Peculiarities in the outgassing curves are attributed to H_2 trapping at a series of sites of different energy. (auth)

22859 (GEMP-497) SOME PHYSICAL AND MECHANICAL PROPERTIES OF W-25Re-30Mo, W-30Re-30Mo, AND W-25Re. Flagella, P. N. (comp.) (General Electric Co., Cincinnati, Ohio. Nuclear Materials and Propulsion Operation). Feb. 6, 1967, Revised Mar. 21, 1967. Contract AT(40-1)-2847. 18p. Dep. mn. CFSTI $3.00 cy, $0.65 mn.

Physical and mechanical property data for W−25Re−30Mo (at. %), W−30Re−30Mo, and W−25Re (wt %) are tabulated. Also, data for some related materials are included for comparison or calculations. (P.C.H.)

22860 (IS-T-148) EFFECT OF CARBON ON THE STRENGTH OF THORIUM. Skaggs, Robert Lee (Ames Lab., Iowa). Feb. 1967. Contract W-7405-eng-82. 79p. Dep. mn. CFSTI $3.00 cy, $0.65 mn.

Thesis.

The flow stress of Th−C alloys containing from 0.008 to 2.83 atom percent carbon was measured over the temperature range from 4.2 to 573°K. Constant strain rate and constant stress measurements of flow stress were made at rates of deformation from 4×10^{-12} to 1.3×10^{-2} per second. The flow stress was found to be composed of a thermally activated component and an athermal component. The thermally activated component increased linearly with carbon content and with the logarithm of the strain rate. The athermal component is a function of C content and of strain. It was, in general, much smaller than the thermally activated component. The strengthening of Th was due to a strong interaction between randomly distributed C atoms and moving dislocations. A yield point was observed which was a maximum at 250°K and decreased at both higher and lower temperatures. The size of the yield point increased with decreasing grain size, slow cooling from recrystallization temperature, and increasing carbon content. (auth)

22861 (IS-T-157) FATIGUE SOFTENING OF COPPER AND COPPER-ALUMINUM ALLOYS. Doyle, Joe Howard (Ames Lab., Iowa). Feb. 1967. Contract W-7405-eng-82. 94p. Dep. mn. CFSTI $3.00 cy, $0.65 mn.

Thesis.

Fatigue softening has been studied in the Cu−Al alloy system using Cu and alloys containing 2, 3.5, and 7 weight percent Al. The samples were prestressed in a partial tensile test and then cyclically loaded in push-pull fatigue. The magnitude of fatigue softening after cyclic loading was found by flow stress measurements and indentation hardness testing to vary directly with the stacking fault energy of the alloys. The Bauschinger effects which occur during the first cycle increase with increasing Al content in these alloys, thus they must be taken into account to prevent them from masking the effects of fatigue softening. (auth)

22862 (NP-16566) RESPONSE OF METALS TO HIGH STRAIN RATES. A Review of the Literature. Kardos, G. (McGill Univ., Montreal (Quebec). Mechanical Engineering Research Labs.). May 1964. 31p. Dep. mn.

A review is presented on the "state of the Art" of high strain-rate response of metals. A qualitative explanation of strain-rate phenomena was obtained from the Metal Physics. Experimental works are reviewed historically and the results of the more recent experiments have been reproduced. (32 references). (auth)

22863 (NP-16673) AGEING IN NIOBIUM-RICH NIOBIUM-HAFNIUM-CARBON ALLOYS. Research Report R 185. Briggs, D. C.; Harmatiuk, L. R. (Department of Energy, Mines and Resources, Ottawa (Ontario). Mines Branch). Sept. 1966. 31p. Dep. mn. Dept. of Energy, Mines and Resources, Ottawa, Can. $0.75.

Dispersion hardening was investigated in Nb alloys with up to 12 wt % and carbon to 0.5 wt %. Experimental techniques included hardness measurement, metallography, and x-ray analysis. Age-hardening was found at 1100 to 1200°C and related to precipitation of the complex monocarbide (Nb,Hf)C. The constitution of the alloys was determined at 1200°C and conclusions drawn concerning the constitution diagram at higher temperatures to 2200°C. A phase resembling the zeta phase in Ta−C alloys was observed in low-carbon alloys. (auth)

22864 (SC-CR-67-2539) REDUCTION OF DUCTILITY BY PRESTRAINING OF MARAGING STEEL AND TWO Ti-ALLOYS. Armenakas, A. E.; Mylonas, C. (Brown Univ., Providence, R. I. Div. of Engineering). Dec. 1965. Contract AT(29-1)-789. 34p. Dep. mn. CFSTI $3.00 cy, $0.65 mn.

For Sandia Corp., Albuquerque, N. Mex.

The reduction of the initial ductility with compressive prestraining has been measured in 18 Ni maraging steel and 6Al−4V and 13V−11Cr−3Al Ti alloys, both in the solution heat treated and the aged condition (after straining). The ductility of the unaged 18 Ni steel dropped abruptly at a prestrain of 0.50. The aged 18 Ni steel and Ti-base alloys showed a more gradual reduction of ductility with increasing prestrain. In 18 Ni steel and the 13V−11Cr−3Al−Ti alloy, aging after straining caused a general decrease of ductility but also a reduction of the prestrain at which the ductility dropped. The embrittlement by prestraining of these alloys was clearly illustrated in the preliminary reversed bend test. A better indication of the influence of prestrain in fracture should be sought with static and dynamic notched bar tests. (P.C.H.)

22865 (TID-23747) STRUCTURE AND PROPERTIES OF SOLID SOLUTIONS. Technical Progress Report No. 7, March 1, 1966-March 1, 1967. Hendrickson, A. A.; Peters, B. C.; Hammar, R. H. (Michigan Technological Univ., Houghton. Dept. of Metallurgical Engineering). Contract AT(11-1)-916. 24p. Dep. mn. CFSTI $3.00 cy, $0.65 mn.

Developments in studies on the causes of solid solution strengthening effects in bcc and fcc metal solutions were investigated. Studies on the fcc solid solutions of Ag consisted of: effects of Sn and In additions on dislocation density and strength of Ag crystals; and preparation of Ag crystals of very low dislocation density for dislocation velocity studies. Research on Nb-base bcc solid solutions was in three areas: effects of substitutional alloying elements on the stress-strain behavior of Nb; effects of Mo and Ta additions on the athermal strength of Nb; and the effects of Mo and Ta additions on the thermally activated deformation of Nb. (P.C.H.)

22866 (UCRL-16957) DISLOCATION SUBSTRUCTURE IN SINGLE CRYSTALS OF HEXAGONAL Ag-Al ORIENTED FOR PRISMATIC SLIP. Okamoto, Paul R. (California Univ., Berkeley. Lawrence Radiation Lab.). June 1966. Contract W-7405-eng-48. 60p. Dep. mn. CFSTI $3.00 cy, $0.65 mn.

Thesis.

Single crystals of hexagonal Ag−33 at. % Al oriented for prismatic slip were deformed at various temperatures between 77 and 500°K. The dislocation distribution was studied by transmission electron microscopy as a function of temperature and strain. Between 77 and 400°K the predominant features of the dislocation are broad slip bands containing a high density of perfect prismatic loops and long clusters of helical dislocations. Below 400°K the prominent features of dislocation distribution change very little with increasing temperature. The effect of increasing total strain on the dislocation distribution is equivalent to a decrease in temperature. The slip bands and surface slip lines correlate with the serrations in the stress-strain curves. Between 400 and 500°K the dislocation distribution becomes uniform and the prominent slip bands are not observed. It is concluded that the dislocation distribution is in good agreement with the distribution expected from the theoretical strengthening mechanisms developed for this alloy. The high density of loops in the slip bands explains the anomalous behavior of the critical resolved shear stress reported by previous investigations. (auth)

22867 (AD-639555) ABOUT THE RELATION OF RECRYSTALLIZATION KINETICS WITH THE RELAXATION OF TENSIONS IN METALS. Aleksandrov, L. N.; Orlov, V. N. Translated from pp 294-9 of Relaksatsionnye Yavleniya Metallakh i Splavakh, Metallurgizdat, Moscow, 1963. 10p. (FTD-TT-65-1872). CFSTI $3.00 cy, $0.65 mn.

The relation between recrystallization kinetics and relaxation of tensions in metals was investigated by the nature of change in internal friction as a function of temperature and time. Studies on W showed that at temperatures of from 500 to 900°C, the relaxa-

tion of intensities is at first due to displacements of double and much larger accumulation of vacancies and after this begins the displacement of singular vacancies and some dislocations. Results are also discussed for Mo. (P.C.H.)

22868 (AEC-tr-6855) CONTRIBUTION TO THE MATERIALS PROPERTIES OF THE CZECHOSLOVAC THICK-WALL REACTOR PRESSURE VESSEL. Beran, Jaroslav (SKODA Works, Pilsen (Czechoslovakia)). Translated by U. E. Wolff (General Electric Co., San Jose, Calif.), from a report. 13p. Dep. mn. CFSTI $3.00 cy, $0.65 mn. JCL $1.60 fs, $0.80 mf.

Small-scale and pilot plant experiments were carried out to determine the effects of heat treatment on the mechanical properties of pressure vessel parts for the first Czechoslovakia nuclear power reactor. Complete heat treatment leading to the best combination of mechanical properties in forgings and in electro slag welded parts of large thickness consists of three steps: single or double normalizing anneal; annealing in the α-γ region; and stress relief anneal. (P.C.H.)

22869 (AEC-tr-6857) CONTRIBUTION TO STRENGTH PROBLEMS OF LARGE REACTOR PRESSURE VESSELS. Stepanek, Stanislav (SKODA Works, Pilsen (Czechoslovakia)). Translated by U. E. Wolff (General Electric Co., San Jose, Calif.), from a report. 14p. Dep. mn. CFSTI $3.00 cy, $0.65 mn. JCL $1.60 fs, $0.80 mf.

The optimum form, with respect to strength, of several pressure vessel parts, and protection of the vessel against brittle fracture were investigated. Design parameters are described for flange joint, drilled portion of the cover, and the nozzles for the gas inlet and outlet. Special attention was given to brittle fractures. Values were obtained for: temperatures at which the vessel has to be held during fabrication before the stress relief anneal, and during the pressure test; and the minimum temperature of the vessel during operation (after proper consideration of the effects on crack end temperature, of irradiation, and of long time operation). From the experimental evidence, it was concluded that it is possible to build cylindrical steel pressure vessels up to 8 m in dia and for a pressure of 90 bar. (P.C.H.)

22870 LIQUIDUS IN THE ALUMINA-RICH SYSTEM La_2O_3–Al_2O_3. Fritsche, Edward T.; Tensmeyer, Lowell G. (Union Carbide Corp., Indianapolis). J. Amer. Ceram. Soc., 50: 167-8(Mar. 21, 1967).

Results of a previous investigation indicated the existence of two compounds, $LaO_3 \cdot Al_2O_3$ and $La_2O_3 \cdot 12Al_2O_3$, in the La_2O_3–Al_2O_3 system. An attempt was made to establish the composition of the so-called 1:12 compound of β-Al_2O_3 structure. Previous results were partially substantiated in that the compound melted congruently. The liquidus maximum, however, was comparatively narrow. The composition at the maximum appeared to be $La_2O_3 \cdot 11Al_2O_3$. The freezing temperature of the compound was found to be 1995°C, higher than the previously reported value. (J.G.B.)

22871 DIFFUSION OF ZIRCONIUM IN ZIRCONIUM HYDRIDE. Bentle, G. G. (Atomics International, Canoga Park, Calif.). J. Amer. Ceram. Soc., 50: 166-7(Mar. 21, 1967).

Diffusion coefficients were determined for the diffusion of Zr in ZrH between 800 and 1000°C. The radioactive tracer, ^{95}Zr, in an aqueous solution with sodium oxalate was applied to the ground surface of ZrH samples. Annealing time was limited to four days or less to minimize decay of ^{95}Zr to ^{95}Nb. The diffusion of ^{95}Zr was attributed to "short circuit" paths, grain boundaries, and dislocations, as well as volume diffusion. (J.G.B.)

22872 PROPERTIES OF CIRCULAR JOINTS OF ZIRCONIUM ALLOY THIN-WALLED PIPES PRODUCED BY SEAM WELDING. Rybakov, Yu. V.; Podvolskii, L. I. Svarochn. Proizv., No. 10, 24-6(Oct. 1966). (In Russian).

The mechanical and corrosion properties of seam-welded Zr metal joints were studied as functions of welding and thermal treatment. It was found that such joints have exceedingly high resistance after welding in a vacuum furnace at 700°C for 30 min. (R.V.J.)

22873 METHOD OF MEASURING THERMAL DIFFUSIVITY BY HEATING OF STEP FUNCTION CHANGE. Kobayasi, Kiyosi; Kumada, Toshiaki (Tohoku Univ., Sendai). Nippon Genshiryoku Gakkaishi, 9: 58-64(Feb. 1967). (In Japanese).

A transient method for quickly measuring the thermal diffusivity of a small solid disk (15 mm diameter, 2 to 10 mm thickness) was developed. The disk is placed in vacuum, and heated from the front by thermal radiation whose intensity is varied in a step function. The resulting change in temperature on the rear face is measured by thermocouple and recorded by osillograph; from this data the thermal diffusivity is calculated. Since each measurement requires only a few seconds, the present method is less stringent regarding stability of ambient temperature as compared to steady methods, while saving time without sacrificing accuracy. The measured values in temperatures ranging from 25° to 700°C on Pb, Cr, and Ni of high purity were within ±5% of values from previously reported measurements. Values for thermal diffusivity of UO_2 pellets were also determined in temperatures ranging from 25 to 800°C. The error was not more than ±5%. The method was tested experimentally in the temperature range between 25 and 800°C, but analysis suggests that more accurate measurements of thermal diffusivity can be made by this technique at higher temperatures. (auth)

22874 SHIELDING PROPERTIES OF THE UPb_3 INTERMETALLIC COMPOUND. Moser, James S.; Rohach, Alfred F. (Iowa State Univ., Ames). Nucl. Eng. Design, 5: 214-20(Mar. 1967).

The results of an analysis demonstrated that UPb_3 should be a very effective shield against gamma radiation. In comparison with lead, UPb_3 effects a substantial reduction in both size and weight of a shield. In addition, the high melting point of UPb_3 (1220°C) gives it a definite advantage over lead. Although fabrication costs were not included in this analysis the literature indicates that UPb_3 can be produced on a price competitive basis. (J.R.D.)

22875 CRITICAL TEMPERATURE OF THE TRANSITION-TO-SUPERCONDUCTING STATE OF THE β PHASE IN THE Nb–Sn–Al–Ge SYSTEM. Alekseevskii, N. E.; Ageev, N. V.; Shamrai, V. F. (Inst. of Metallurgy, Moscow). Izv. Akad. Nauk SSSR, Neorg. Mater., 2: 2156-61(Dec. 1966). (In Russian).

Beta-alloys of the Nb–Sn–Al–Ge system with various contents of the alloying elements were levitation melted from 99.8%-pure Nb and 99.999%-pure Al, Sn, and Ge, homogenized at 600°C for 250 hr, and water quenched. Nb_3Sn, Nb_3Al, and Nb_3Ge compounds were found to have a temperature of transition to the superconducting state (T_{cr}) of 18.1, 17.4, and 7.1°K, respectively. With increasing Sn content in alloys of the pseudobinary Nb_3Sn–Nb_3Al section, T_{cr} gradually decreased, reached a minimum at the Sn:Al ratio of 1:1, and gradually increased again with a further increase in the Sn content. In alloys of the Nb_3Sn–Nb_3Ge section, T_{cr} dropped sharply with an increase of Nb_3Ge content to about 70%, and then remained almost constant. With small increases in the Ge content of alloys along the Nb_3Al–Nb_3Ge section, T_{cr} slightly increased to a maximum in an alloy with a 4:1 Al:Ge ratio, and then decreased continuously with increasing Ge content. The composition dependence of T_{cr} in the Nb_3Sn–Nb_3Al–Nb_3Ge section is shown. The critical temperature T_{cr} was also found to increase with the increasing degree of ordering of the investigated alloys. In the Nb–Sn–Al–Ge system, the value of T_{cr} appears to be determined mainly by the density of states at the Fermi surface. (ATD)

22876 MECHANICAL PROPERTIES OF HIGH-MELTING-POINT METALS. Klypin, B. A.; Gulyaev, A. P.; Morgunova, N. N. (Central Scientific-Research Inst. of Ferrous Metals, USSR). Metalloved. Term. Obrabotka Metal., No. 12, 15-21 (Dec. 1966). (In Russian).

The effect of impurity content, structural state, and deformation rate on the mechanical properties of Nb, Ta, Mo, and W were considered over a low-temperature region of ~0.2 T_m, an intermediate-temperature region of 0.2 to 0.5 T_m, and a high-temperature region of >0.5 T_m. At T_m <0.2, Mo and W had higher transition temperatures into intermediate temperature region than Nb and Ta. An increase in deformation rate increased this transition temperature more for Mo and W than for Nb and Ta. The transition from the intermediate-temperature region to the high-temperature region was determined empirically by the deformation rate as follows: $T_{tr} = (0.57 + 0.03 \lg \epsilon) T_m$. Here T_{tr} is the transition temperature; ϵ is the deformation rate in sec^{-1}, and T_m is the melting temperature. Impurity content and structural state had hardly any effects on the transition temperature. At temperatures above 0.5 T_m, the strength properties did not depend on the nature of the metal, impurity content, or initial structure. The strength properties of various metals as a function of temperatures are given by the general equation: $\sigma = a' \exp(-m'T/T_m)$. Here a' and m' are coefficients depending on the method of testing and the rate of deformation. The high-heat strength of the refractory metals is due to their high-melting points. (TTT)

22877 PHYSICO-CHEMICAL THEORY OF HEAT RESISTANCE OF HIGH-MELTING-POINT METALS AND ALLOYS. Kornilov, I. I. (Inst. of Metallurgy, Academy of Sciences, USSR). Metalloved. Term. Obrabotka Metal., No. 12, 5-14(Dec. 1966). (In Russian).

Methods of improving the high-temperature strength of Nb, Ta, Mo, and W are discussed. Strengthening by solid solution is one important method of improving the heat strength of these four metals. The greater the number of components and the more complex the system, the better is the heat strength. The most interesting of the continuous solid solutions are the following: Nb–Ta; Nb–Mo; Nb–W; Ta–Mo; Ta–W; Mo–W; Nb–Ta–Mo; Nb–Ta–W;

Ta–Mo–W and Nb–Ta–Mo–W. The system W–Mo–Ta–Nb–V should yield alloys having high-heat strength. Dispersion strengthening is the other important method of obtaining alloys with high-heat strength. The light elements B, C, Si, N and O form refractory compounds with W, Mo, Ta and Nb, which can be used for dispersion strengthening. With the use of these mechanisms of strengthening W, Ta, Mo and Nb, it should be possible to extend the heat strength from the present 0.4 $T_{melt.}$ to 0.6, 0.7 or even 0.8 $T_{melt.}$ (TTT)

22878 PROPERTIES OF POLYCRYSTALLINE UNALLOYED MOLYBDENUM. Zaboronok, G. F.; Milova, V. B.; Polyakova, M. D.; Simonishvili, T. V. Metalloved. Term. Obrabotka Metal., No. 12, 49-50(Dec. 1966). (In Russian).

Polycrystalline unalloyed Mo was produced by electron-beam fusion without the use of deoxidizers. Rods 12 to 15 mm dia or a billet 5 to 7 mm thick were subjected to hot rolling. The Rockwell hardness was found to be 153 for the cast Mo, 167 for cold-worked Mo, and 154 kg/mm^2 for recrystallized Mo. The corresponding microhardness values were 204, 215, and 203 kg/mm^2 respectively. The electrical resistance was 0.0567 for cold-worked and 0.0557 ohm-mm^2 m^{-1} for recrystallized Mo. The elastic modulus E was 31,180 for cold-worked Mo and 33,170 kg/mm^2 for recrystallized Mo. The shear modulus G was 12,340 for cold-worked Mo and 12,475 kg/mm^2 for recrystallized Mo. At a deformation rate of 3 mm/min, the strength decreased with an increase in annealing temperature with a decrease in the rate of drop in strength at 1050 to 1150°C. A maximum of 16.4% relative elongation was obtained at an annealing temperature of 800°C. (TTT)

22879 MAGNETIC STRUCTURE OF GADOLINIUM. Belov, K. P.; Ergin, Yu. V. (Moscow State Univ.). Izv. Akad. Nauk SSSR, Ser. Fiz., 30: 975-8(June 1966). (In Russian).

The temperature and magnetic-field dependence of the electrical resistivity of Gd crystals has been compared with the corresponding dependences in Tb and Dy in order to determine whether Gd has a noncollinear magnetic structure at temperatures slightly below the Curie point similar to that detected in Tb, Dy, and most rare earth ferromagnets by neutron diffraction experiments (neutron diffraction in the case of Gd is difficult to investigate because of the large absorption cross section). The resistivity of Gd in the direction of the c axis was found to have a maximum at about 290°K analogous to (but less marked than) the maxima exhibited by the resistivities of Tb and Dy at 220 and 170°K, respectively. The anomalous temperature dependence of the resistivity along the c axis disappeared in a sufficiently strong magnetic field (above 0.3, 1.8, and 15 kOe for Tb, Gd, and Dy, respectively). From this behavior of the resistivity and from the temperature dependence of the galvanomagnetic effect and the magnetostriction of Gd reported elsewhere it is concluded that Gd has a noncollinear atomic magnetic structure at temperatures above about 210°K. In the absence of accurate neutron diffraction data it is not possible to determine whether this complex structure is of the antiferromagnetic or the ferromagnetic type. (ATD)

22880 CONTRIBUTION OF THE MAGNETOELASTIC ENERGY TO THE UNIAXIAL MAGNETIC ANISOTROPY ENERGY OF DYSPROSIUM. Levitin, R. Z.; Ponomarev, B. K. Izv. Akad. Nauk SSSR, Ser. Fiz., 30: 981-3(June 1966). (In Russian).

The magnetostriction of Dy single crystals in a hard magnetization direction (the c axis) was measured in pulsed fields up to 150 kOe at temperatures from 129 to 300°K in order to test the hypothesis of A. Clark, B. DeSavage, and R. Bozorth (Phys. Rev., A. 138: 216(1965)) that the large uniaxial magnetic anisotropy of Dy is due to magnetostrictive interaction. The magnetostriction was found to vary quadratically with the field in the paramagnetic region (above 178°K) and to reach values of the order of 3×10^{-3}. At lower temperatures the magnetostriction increased rapidly and reached the value of 0.7×10^{-2} at 129°K in a 150-kOe field, where it was still far from saturated. Possible reasons for the magnetostriction are discussed briefly, and it is concluded that Dy has a helicoidal magnetic structure at temperatures between 85 and 178°K. The magnetoelastic and uniaxial magnetic anisotropy energies of Dy are compared, and it is shown that the former is an appreciable fraction of the latter. It is concluded that the magnetoelastic interaction must be taken into account in any theory of the magnetic anisotropy of the rare earth metals. The magnetostriction measurements in pulsed fields at temperatures below 129°K were not reproducible; this is ascribed to magnetostrictive deformation of the specimens beyond their elastic limits. (ATD)

22881 ROLE OF ZIRCONIUM IN ZINC–COPPER ALLOYS. Piotrowski, Waclaw. Rudy Metale Niezelazne, 12: 2-6(1967). (In Polish).

The structure of chill castings and worked Zn–Cu–Zr alloys was investigated and the mechanical properties of the hot and cold rolled alloys were determined. It was found that Zr additions of 0.01 to 0.04% ensured a fine-grained structure to the chill castings and that useful gains in the mechanical properties could be achieved by adding Zr to Zn–Cu alloys. The most satisfactory strength properties were exhibited by sheets cold rolled on finishing mills and especially when the rolling direction was changed 90° in relation to the hot rolling direction of the roughing mill. (auth)

22882 WHISKER-STRENGTHENED METALS. Levitt, Albert P. (Army Materials Research Agency, Watertown, Mass.). Mech. Eng., 89: No. 1, 36-42(Jan. 1967).

Progress in the technology of whisker-strengthened metals is reported. Properties of metal–whisker composites of Ag–Al_2O_3, Al–Al_2O_3 (made by infiltration of aligned whisker bundles by molten metals), and Al–$CuAl_2$, Al–Al_3Ni, and Ta–Ta_2C (made by unidirectional solidification) were studied and compared with super-alloys and refractory metals. The latter technique had the advantage of producing a composite whose whiskers were incorporated, spatially distributed, aligned, and well bonded to the matrix during the process. Whisker-strengthened metals have high strength, low ductility, good stiffness, toughness, and impact resistance. They are generally several times stronger than the unreinforced metal at both room and elevated temperatures. (P.C.S.)

22883 EFFECTS OF HEATING UP TO PRE-CRYSTALLIZATION POINT ON THE CHANGES IN THE DUCTILITY AND STRUCTURE OF COLD-ROLLED TITANIUM AND ZIRCONIUM. Gorelik, S. S.; Spektor, E. N.; Dolgaya, Zh. A. (Moscow Inst. of Steel and Alloys). Izv. Vyssh. Ucheb. Zaved., Tsvetn. Met., No. 6, 127-9 (1966). (In Russian).

Ductility and structural changes were studied in Ti and Zr heated to a precrystallization point and cold-rolled, and with hexagonal close-packed lattices with a close c/a ratio and identical polymorphous transformation temperature. Zr exhibited 60% deformation and Ti, 20 and 60%. A maximum increase in ductility was observed at certain precrystallization temperatures. (R.V.J.)

22884 DIFFERENTIAL THERMAL ANALYSIS FOR DETERMINATION OF THE ENTHALPIES OF MELTING OF METALS AND ALLOYS AT TEMPERATURES TO 1200°C. Lugscheider, Walter (Technische Hochschule, Vienna). Ber. Bunsenges. Phys. Chem., 71: 228-35(Apr. 1967). (In German).

A special apparatus for the differential thermal analysis (DTA) of highly reactive alloys at high temperature was designed, and a quantitative treatment of the DTA-curves for determining enthalpies of melting was developed. The proportionality constant for the quantitative treatment was calculated and checked by calibration measurements. The marked increase, corresponding to the T^4-law, of the proportionality constant brought about a doubling of the error of measurement even at 1100°C, so that determination of heats of reaction by the DTA-method seems certain only up to about 1000°C. At higher temperatures, in particular above 1200°C, the results were considered only as estimates. A sharp separation of reaction was obtained within very small temperature intervals; thus the determination of enthalpies of melting for incongruently melting intermetallic phases is possible. Thermochemical data for peritectically reacting compounds in the systems Sm–Hg and Gd–Mn were obtained. (auth)

Structure and Phase Studies

Refer also to abstracts 21860, 21909, 22202, and 22881.

22885 (AFML-TR-66-259) INVESTIGATION OF PRECIPITATES IN TWO CARBON-CONTAINING COLUMBIUM-BASE ALLOYS. Ostermann, F.; Bollenrath, F. (Air Force Materials Lab., Wright-Patterson AFB, Ohio). May 30, 1966. 65p. CFSTI.

The precipitates in the commercial Nb alloys D-31 and D-43 were investigated after various heat treatments. The Ti-rich and Zr-rich monocarbides are the only stable precipitate phases in alloys D-31 and D-43, respectively. The temperatures for complete solid solution are 1600°C for alloy D-31 and 1700°C for alloy D-43 corresponding to a C content of about 0.09 wt %. Non-equilibrium Nb Carbides precipitate even during quenching from solid solution, so that no appreciable C supersaturation can be achieved in Nb alloys. During aging, the stable monocarbides form at the expense of the non-equilibrium Nb Carbides but not from solid solution. Therefore, age-hardening caused by stable MC-phase precipitation does not occur. The effect of O_2 on carbide precipitates was investigated by increasing the O_2 concentration of the alloys on purpose. O_2 behaved differently in both alloys with respect to precipitate phases. A Nb Carbide phase with unknown lattice structure but a composition corresponding approximately to Nb_3C_2 was found in both alloys after suitable heat treatments. (auth)

22886 (CALT-221-29) FURTHER APPLICATIONS OF THE THEORY OF PARTICLE COARSENING. Ardell, A. J. (Cali-

fornia Inst. of Tech., Pasadena. W. M. Keck Lab. of Engineering Materials). Feb. 1967. Contract AT(04-3)-221. 14p. Dep. mn. CFSTI $3.00 cy, $0.65 mn.

Concentration changes during coarsening, which occurs only by the diffusion-controlled transfer of solute in the matrix, were studied. The results were used to derive quantitative information about the particle-matrix interfacial free energy in well-behaved systems, which is exemplified by data for the coarsening of γ' in Ni–Ti alloys. (P.C.H.)

22887 (EURAEC-1648) STUDY OF THE AUSTENITIC GRAIN GROWTH OF FIVE STEELS UNDER THE INFLUENCE OF HEAT CYCLES SIMULATING VERTICAL SLAG WELDING CONDITIONS. Special Report No. 11, January 1–March 31, 1966. (Chantiers de l'Atlantique Saint-Nazaire (France)). Contract 054-61-12-RDF. 15p. (EUR-2846). Dep. mn. CFSTI $3.00 cy, $0.65 mn.

Work Performed under United States–Euratom Joint Research and Development Program.

A method of studying austenitic grain growth under the influence of heat cycles simulating vertical slag welding was applied to five steels to compare their suitability for overheating. Both hot microscopy and standard microscopy were performed. It was concluded that the austenitic grain quickly reaches a limit size, which varies little thereafter, at least in the conditions of treatment adopted. The limit sizes did not allow very precise classification of the steels in order of increasing resistance to overheating. There was found to be very good agreement between hot microscopy pictures, thermal attack photography, and the steel structure in depth. (M.C.G.)

22888 (MLM-1346) REACTOR FUELS AND MATERIALS DEVELOPMENT PLUTONIUM RESEARCH: JANUARY–MARCH 1966. Wittenberg, L. J.; Grove, G. R. (Mound Lab., Miamisburg, Ohio). Apr. 7, 1967. Contract AT(33-1)-Gen-53. 34p. Dep. mn. CFSTI $3.00 cy, $0.65 mn.

Developments are reported for studies on: Pu–U–Zr ternary system; grain boundary relaxation in α U; heat capacity of δ' Pu; densities of liquid Pu–Ce alloys; viscosities of liquid Au, Pb, and U; and Pu–O systems. (P.C.H.)

22889 (N-66-21790) O VLIYANII KRISTALLICHESKOI STRUKTURY URANA NA KINETIKU ROSTA INTERMETALLICHESKOI FAZY UCu_5. (Effect of Crystal Structure of Uranium on the Growth of Intermetallic Phase UCu_5). Matyja, H.; Gabrycki, St. (Institute of Nuclear Research, Warsaw (Poland)). 1965. 20p. (In Russian). (INR-648/XIV/PS). CFSTI $3.00 cy, $0.65 mn.

Diffusion layer–growth in interdiffusion in the Au–U system has been investigated in details over the temperature range 570–910°C. The value of the activation energies and coefficients k_0 have been determined. It has been found that the velocity of the diffusion layer growth changes abruptly near temperatures of allotropic points of U. An explanation for this effect is given. (auth)

22890 (NUMEC-3428-29) GROWTH OF SINGLE CRYSTALS OF PLUTONIUM. Progress Report, October 1, 1966–December 31, 1966. (Nuclear Materials and Equipment Corp., Apollo, Pa.). Mar. 1967. Contract AT(30-1)-3428. 18p. Dep. mn. CFSTI $3.00 cy, $0.65 mn.

Large grains of α Pu (~0.75 mm average diameter) were grown using a variety of experimental conditions. All of the high pressure runs in this series were done at a temperature of 425°C using four hour holding times. This series of experiments completes a parametric study concerning the effects of varying cooling rates, pressure, and temperature of high pressure release prior to cooling with respect to the observed α Pu microstructure. The isothermal transformation of experimentally melted and solidified β Pu for 800 hours at 106.5 ± 0.5°C resulted in a highly sub-grained α Pu microstructure which exhibited a three volume percent dispersion of voids. The density of the α Pu decreased by 0.68 g/cm³ from the original as-cast density of 19.55 g/cm³. The resulting α Pu microstructure had an average grain size of 0.3 mm. (auth)

22891 CRYSTALLINE STRUCTURE OF THE Sc–Zn SYSTEM. Kripyakevich, P. I.; Protasov, V. S.; Kuz'ma, Yu. B. (Lvov State Univ.). Izv. Akad. Nauk SSSR, Neorg. Mater., 2: 1574-80(Sept. 1966). (In Russian).

X-ray studies of the Sc–Zn system revealed the existence of $ScZn_{12}$ with a structure similar to $ThMn_{12}$ (a = 8.814 ± 0.005 Å, C = 5.140 ± 0.004 Å, and c/a = 0.583) and a second compound, Sc_4Zn_7, with 80 at. % Zn and a cubic structure (a = 13.79 ± 0.02 Å) similar to Ru_3Be_{17}. (R.V.J.)

22892 STUDY OF ALUMINUM-RICH ALLOYS OF THE Zr–Ni–Al SYSTEM. Markiv, V. Ya.; Matushevskaya, N. F.; Rozum, S. N.; Kuz'ma, Yu. B. (Lvov State Univ.). Izv. Akad. Nauk SSSR, Neorg. Mater., 2: 1581-5(Sept. 1966). (In Russian).

Ninety-nine Al rich alloys of the Zr–Ni–Al system containing up to 33 at. % Zr and up to 75 at. % Ni have been melted from high-purity components and their phase composition and crystal structure investigated. On the basis of obtained results, an isothermal (800°C) section of the ternary diagram was plotted. Five ternary compounds were identified in the alloys: $ZrNi_3Al$ (a = 6.123 Å) and $ZrNi_{0.5-0.2}Al_{1.5-1.8}$ (a = 7.355–7.444 Å) with respective structures of $MnCu_2Al$ and $MgCu_2$ type; $Zr_{0.4}Ni_{1.2}Al_2$ (a = 12.08 Å) with a cubic structure; ZrNiAl (a = 6.93 Å; c = 3.47 Å; c/a = 0.50) with a hexagonal lattice; and $ZrNiAl_4$, whose structure has not been determined. (ATD)

Radiation Effects

Refer also to abstract 23603.

22893 (BNWL-SA-372) IMPROVED POSTIRRADIATION TENSILE AND STRESS-RUPTURE PROPERTIES OF HASTELLOY X-280. Levy, I. S.; Wheeler, K. R. (Battelle-Northwest, Richland, Wash. Pacific Northwest Lab.). Mar. 18, 1966. Contract AT(45-1)-1830. 56p. (CONF-660607-8). Dep. CFSTI.

From 3rd International Symposium on the Effects of Irradiation on Structural Metals, Atlantic City.

Tensile and stress-rupture specimens of Hastelloy X-280, a solution-hardenable Ni-base alloy, were given various preirradiation experimental thermomechanical treatments. The specimens were subsequently irradiated at 540°F to exposures of approximately 1×10^{20} nvt (E > 1 MeV) and 3×10^{20} nvt thermal. Tensile tests were performed at room temperature and 1350°F in air and the stress-rupture tests were performed at 1350°F in air. The tensile tests showed that, when compared with a standard commercial treatment, the experimental treatments generally reduced radiation damage. Some treatments increased postirradiation high temperature tensile ductility by 100% while maintaining strength. One treatment resulted in increases in postirradiation high temperature yield strength and ultimate strength of 100 and 25%, respectively, with only a 2 to 4% ductility loss. Further, a maximum increase of 57% in postirradiation room temperature yield strength was possible while maintaining at least 18% uniform elongation. The stress-rupture tests showed that some treatments increased postirradiation rupture life up to 106% with no change in postirradiation minimum creep rate. These treatments increased duration of postirradiation secondary creep up to 107% and increased the duration of postirradiation tertiary creep up to 115%. Metallography of broken tensile specimens showed evidence of strain-induced precipitation, radioinduced precipitation, and combined strain- and radioinduced precipitation. Property improvements were interpreted on the basis of the interaction of the microstructures formed by the preirradiation treatments with the neutron environment and subsequent thermal and stress environments associated with the testing. Relationships of these results to reactor material fabrication are considered. (auth)

22894 (EURAEC-1784) IN-PILE CORROSION OF NUCLEAR MATERIALS. Quarterly Report No. 5, June 1–August 31, 1966. (Centre d'Etude de l'Energie Nucleaire, Mol (Belgium)). Contract 055-65-3-TEEB(RD). 35p. (EUR-3326). Dep. mn. CFSTI $3.00 cy, $0.65 mn.

Work Performed under United States–Euratom Joint Research and Development Program.

In order to determine the effect of radiolysis of water on the electrochemical behavior of steel and Pt, systematic irradiation experiments with a Co source were carried out in acid solutions of ferrous and ferric ions, with additions of chlorides or alcohol or both. The radiolysis of these solutions was followed by recording the potential E_{Pt} of platinum versus a Ag/AgCl reference electrode during and after γ irradiation. Different types of (E_{Pt}-absorbed dose) diagrams were established, which showed potential increases and decreases, maxima and minima, depending on the experimental conditions. After thus following the radiolysis redox behavior, the open-circuit potentials of passivated and activated steel samples were measured as a function of time, (E_{SS}-time), in solutions irradiated up to particular points in the (E_{Pt}-dose) diagrams. A set of widely varying conditions in the solutions was thus obtained and the influence on the steel measured. Depending on these environmental conditions, activation of passive samples, passivation of active samples, and pitting phenomena were observed. Analyses of the irradiated solutions furnished information concerning the ions present at different irradiation stages. The strong reducing effect of organic impurities on, e.g., Fe^{3+} ions, during irradiation was demonstrated. These results together with literature data allowed an explanation of the main features of the (E_{Pt}-dose) curves: the platinum electrode functions either as an indicator for the available oxidation-reduction couples or as a hydrogen electrode, depending on the irradiation and "cooling" history of the solution. The (E_{SS}-time) curves were interpreted according to the aspect of the

steel electrode after the test, which gave evidence of activation, passivation, and pitting. In addition, a start was made with potentiodynamic experiments which should at the end provide a complete explanation of the recorded variations of E_{SS} with time. (auth)

22895 (EURAEC-1816) INFLUENCE OF NITROGEN IN IRON AND STEEL UNDER FAST NEUTRON IRRADIATION. Quarterly Report No. 5, October 1–December 31, 1966. (Societa Ricerche Impianti Nucleari, Saluggia (Italy). Centro Ricerche Nucleari). Feb. 1967. Contract 074-65-10-TEEI(RD). 12p. (EUR-3352; M-482). Dep. mn. CFSTI $3.00 cy, $0.65 mn.

Work Performed under United States–Euratom Joint Research and Development Program.

Measurements were made of the tensile properties of irradiated Ferrovac E at different temperatures and strain rates: the range of strain rates is now from 1.5×10^{-5} to 2×10^{-1} sec^{-1}. Transition temperature measurements were made of Si- and Al-killed ASTM A 212 base steels after irradiation. The nitrogen distribution in ASTM A 212 steels, quenched and aged at 600°C, was analyzed and compared with results of studies on the mechanical properties of the materials. Magnetic viscosity studies were carried out on Fe–Si 6.5% alloys. Damage dosimetry studies were carried out with measurement of the shielding effect in iron and of the spectrum perturbation due to the iron specimens in the irradiation environments. (auth)

22896 (ORNL-4097) RADIATION METALLURGY SECTION, SOLID STATE DIVISION PROGRESS REPORT FOR PERIOD ENDING JANUARY 1967. (Oak Ridge National Lab., Tenn.). Apr. 1967. Contract W-7405-eng-26. 53p. Dep. mn. CFSTI $3.00 cy, $0.65 mn.

Studies on the radiation embrittlement of weld heat-affected-zone samples and base plate of ASTM A-212B pressure-vessel steel showed the effects of irradiation temperature on the shift of ductile brittle transition temperature of base plate and HAZ specimens. Heat to heat variations of sensitivity to radiation embrittlement were quite striking. Studies of the increase of yield stress of ferrovac-E iron samples irradiated to the same dose but at different rates have now been completed. No effect of dose rate on yield stress increase was observed for dose rates ranging from about 1.7×10^{11} neutrons/cm^2 sec to 2.3×10^{13} neutrons/cm^2 sec (E > 1 Mev). Studies of annealing of radiation hardening were carried out in the temperature range from 300 to 400°C. It was observed that the radiation damage became more stable with increasing dose in the interval 4×10^{17} to 5×10^{18} neutrons/cm^2 (E > 1 Mev). Studies were also carried out which indicate an effect of interstitial impurities in producing radiation hardening. The temperature and strain rate dependence of the flow stress of irradiated polycrystalline iron specimens was tested. The activation volume was not changed by irradiation while the activation energy was increased by irradiation. A niobium single crystal with a total impurity content of <75 ppM and a resistivity ratio R 300/R 4.2 = 1420 was produced. An annealing procedure for improving the perfection of niobium single crystals was determined and x-ray topographs of the resulting crystals were made. Studies of dislocation motion in niobium single crystals using etch pits were continued and procedures for decorating dislocations in very high purity niobium were determined. Stage II annealing in irradiated niobium was studied using internal friction and resistivity measurements. The results showed that Stage III annealing is due to migration of oxygen atoms to radiation produced defects. (P.C.H.)

22897 (WAPD-T-1834) CONSIDERATIONS ON THE ANNEALING OF IRRADIATED PRESSURE VESSEL STEEL. Seman, D. J.; Pasierb, E. J. (Bettis Atomic Power Lab., West Mifflin, Pa.). Oct. 1965. Contract AT(11-1)-Gen-14. 12p. (CONF-651101-51). Dep. mn. CFSTI $3.00 cy, $0.65 mn.

From 13th Conference on Remote Systems Technology, Washington, D. C.

The benefit or lack of benefit of an annealing treatment for irradiated pressure vessel steels is considered. Conflicts in conclusions of published data on re-irradiation effects are resolved, and a model for the irradiation damage path following irradiation and annealing is proposed. It was concluded that the annealing of irradiated pressure vessel steels in the range of 650 to 800°F will effect a permanent benefit. Neutron spectra should be considered in investigations where comparison of data obtained from different environments is made. (P.C.H.)

22898 HIGH TEMPERATURE TENSILE PROPERTIES OF NEUTRON IRRADIATED 20Cr–35Ni AUSTENITIC STEEL. Roy, R. B.; Solly, B. (Aktiebolaget Atomenergi, Studsvik, Sweden). Z. Metallk., 58: 258-62(Apr. 1967).

The embrittlement of 20Cr–35Ni austenitic steel in the unirradiated condition at temperatures of 750°C and above is due to the formation and link-up of grain boundary cavities. Grain boundary precipitation due to prolonged annealing at 650°C has no significant effect on the tensile properties. At 750 and 820°C the increased embrittlement of irradiated specimens is due to an increase in the nucleation and growth rate of grain boundary cavities. It is suggested that this is due to helium atoms produced during irradiation migrating to the grain boundary cavities and thus decreasing both the critical radius and external stress needed for cavity growth. Presence of lithium at grain boundaries will reduce the surface energy and facilitate nucleation and growth of cavities. Radioinduced reduction in ductility at 650°C tests in this alloy was caused by catastrophic growth of triple point wedge cracks. Presence of Li and He atoms at the grain boundary due to transmutation of B, was responsible for catastrophic growth of these cracks. (auth)

22899 NEUTRON IRRADIATION AND THE YIELD SURFACES OF COPPER. Dudderar, T. D. (Bell Telephone Labs., Murray Hill, N. J.); Duffy, J. J. Appl. Mech., 34: 200-6(Mar. 1967).

Tests were conducted to determine the effects of irradiation and plastic deformation on the yield surfaces of polycrystalline Cu. It was found that the principal effect of plastic deformation on unirradiated Cu was to translate the yield surface without appreciably changing its size or shape. Irradiation, on the other hand, produced a very large change in the overall size of the initial yield surface; in other words, it produced an effect phenomenologically similar to extensive isotropic strain hardening. In addition, the shape of the initial yield surface after irradiation was dependent on the plastic strain offset chosen to define yield. This effect was not observed for the unirradiated metal. Extensive plastic deformation after irradiation caused the yield surface to translate and grow smaller without significantly changing shape. (auth)

22900 IRRADIATION BEHAVIOR OF URANIUM FUEL TUBES IN A PRESSURIZED HEAVY-WATER REACTOR. Angerman, C. L.; McDonell, W. R. (E. I. du Pont de Nemours and Co., Aiken, S. C.). Contract AT(07-2)-1. Nucl. Sci. Eng., 28: 42-50(Apr. 1967).

Zircaloy-clad U metal fuel tubes containing dilute (<1000 ppM) Fe, Si, and Al additions, which were irradiated under 1200 psi reactor pressure to about 5000 megawatt days per metric ton of U (MWd/tU), swelled less than 3%; in contrast, U–1.5 wt % Mo and unalloyed U tubes swelled 6 to 10%. External restraints provided by thick cladding and reactor pressurization contributed substantially to the volume stability of the tubes by limiting the volume increase that would normally be encountered at exposures beyond the characteristic threshold for swelling. (auth)

Ceramics and Cermets

Refer also to abstract 23589.

Corrosion and Erosion

22901 CORROSION OF INSULATION CERAMIC MATERIALS IN HIGH-TEMPERATURE COOLANTS. Budnikov, P. P.; Kharitonov, F. Ya.; Anisimova, S. V. (Moscow Chemical-Technological Inst.). Zh. Prikl. Khim., 40: 549-55(Mar. 1967). (In Russian).

The intense disintegration by water vapor of liquid-glass composition materials, electroporcelain, steatite, forsterite, and wollastonite, leading to density loss (increased water absorption and porosity) was studied. The loss of stability as a result of the formation of hydrated ions of the corresponding metals and silicates under water-vapor conditions was also established. The least affected under these conditions were mullite- and Al_2O_3-based materials. The most corrosion-resistant materials in melts of Na and K at 400 and 700°C were samples from corundum microlite and the Al_2O_3 material A-1, maintaining satisfactory density and stability. The reduction of a series of physical and chemical properties of ceramics as a result of tests in agressive media appears to be a result of the aging of the ceramics during extended exposure in the medium, connected with the change in the composition and microstructure, and arising as a result of adsorption, hydration, and hydrolysis of their components. (tr-auth)

Preparation and Fabrication

Refer also to abstracts 21858, 22854, 22882, 22920, and 23716.

22902 (AECL-2633) FABRICATION AND MECHANICAL PROPERTIES OF SINTERED ZIRCONIUM–YTTRIA DISPERSIONS. Rezek, J.; Childs, B. G. (Atomic Energy of Canada Ltd., Chalk River (Ontario)). Jan. 1967. 92p. (CR-MET-1248). Dep. mn. CFSTI $3.00 cy, $0.65 mn. AECL $2.00.

Various stages in the development of a route for fabricating

Zr–Y oxide dispersions are described together with the improvements in stress-rupture properties resulting from each stage. The best properties were achieved with a 5 volume % dispersion of fused crushed and sized (<0.5 μm) Y_2O_3 particles where the dispersion was subjected to a double cycle of fabrication with an intermediate rehydriding step. The rupture time and minimum creep rate of this material at 500°C were improved roughly tenfold over the corresponding properties for sintered Zr. The improvement is ascribed to the stabilizing effects of the particles on the grain structure. No strength contribution from direct dislocation-particle-interaction was detectable. Some subsidiary experiments on the production and properties of Zr–Y_2O_3 and Zr–Ce_2S_3 sulfide alloys by arc-melting and heat treatment are also described. (auth)

22903 (GEAP-5402) POWER REACTOR HIGH PERFORMANCE UO_2 PROGRAM. Progress Report No. 1, July–October 1966. Arlt, W. H.; Barth, N. H.; Lees, E. A.; Lyons, M. E.; Weiss, D. T. (General Electric Co., Pleasanton, Calif. Nuclear Technology Dept.). Dec. 1966. Contract AT(04-3)-189. 51p. (EURAEC-1820). Dep. mn. CFSTI $3.00 cy, $0.65 mn.

Work Performed under United States–Euratom Joint Research and Development Program.

Design efforts for the development of Zircaloy-2-clad UO_2 fuel rods for irradiation to varying degrees of central melting in an operating power reactor are reported. The results of thermal-hydraulic and physics analyses are given. (P.C.H.)

22904 (ORNL-P-2796) PREPARATION OF REACTOR FUELS BY SOL-GEL PROCESSES. Haas, P. A.; Kitts, F. G.; Beutler, H. (Oak Ridge National Lab., Tenn.). [1966]. Contract W-7405-eng-26. 32p. (CONF-670506-1). Dep. mn. CFSTI $3.00 cy, $0.65 mn.

From 62nd National Meeting of The American Institute of Chemical Engineers, Salt Lake City, Utah.

Sol–gel processes were developed and applied at the Oak Ridge National Laboratory for preparation of high density ThO_2 and/or UO_2 fragments or microspheres. Continued development of these processes for other oxides and for large-scale applications is reported. Relatively high-strength, spherical particles of ThO_2, UO_2, PuO_2, and their binary mixtures were prepared with diameters of 50 to 700 μ and densities of 90 to 100% theoretical. Sols, dispersed as drops in 2-ethyl-1-hexanol, were converted to gel spheres by extraction of water. Sol preparation and microsphere forming equipment presently in operation have capacities of over 10, 1, and 0.1 kg/day for ThO_2, UO_2, and PuO_2, respectively. Procedures for remote or shielded operation of such equipment and improved apparatus for dispersion of sols into uniform drops were tested. The PuO_2 sols are prepared from $Pu(NO_3)_4$ solution by a precipitation–peptization technique. Sol–gel microspheres show unusual drying and sintering characteristics. They lose up to 15% of their original weight and show up to 34% linear shrinkage; yet unusually high densities are obtained at relatively low temperatures. This behavior is being studied to determine mechanisms and better process flowsheet conditions. (auth)

22905 (ORNL-TM-1322) FABRICATION AND PREIRRADIATION INFORMATION ON VIBRATORILY COMPACTED ThO_2–UO_2 FUEL RODS FOR EXPERIMENTS ETR-I AND MTR-III. Olsen, A. R.; Rabin, S. A.; Snider, J. W.; Ernst, W. S.; Tackett, J. W. (Oak Ridge National Lab., Tenn.). Jan. 1966. Contract W-7405-eng-26. 34p. Dep. mn. CFSTI $3.00 cy, $0.65 mn.

The irradiation behavior of powder packed sol-gel ThO_2-base fuels is being evaluated. Ten capsules containing ThO_2–5.7% UO_2 were fabricated and then irradiated in the ETR and MTR process water at very high thermal ratings. The principal fabrication variable considered was the gel calcining atmosphere. The oxide for the various rods was fired in Ar–4% H_2, air, or N_2. All of the capsules irradiated contained a ternary particle-size distribution except for one binary with air-fired material. Fabrication of the capsules is described and pertinent preirradiation data and predicted irradiation conditions are presented. Irradiation started during the latter part of 1963. The MTR specimens are operating at an estimated peak linear heat rating of 85,000 Btu hr^{-1} ft^{-1}, and the intended peak burnup is 100,000 MWd per metric ton of metal. The ETR specimens, which were discharged in May 1964, ran at an estimated peak heat rating of 149,000 Btu hr^{-1} ft^{-1} to an estimated peak burnup of 22,000 MWd per metric ton of metal. (auth)

22906 (TID-23792) DIELECTRIC STRENGTH AND FERROELECTRIC BEHAVIOR OF CERAMICS. Quarterly Progress Report No. 2, May 1, 1963–August 1, 1963. (Rutgers–The State Univ., New Brunswick, School of Ceramics). Contract AT(29-1)-789. 27p. Dep. mn. CFSTI $3.00 cy, $0.65 mn.

For Sandia Corp., Albuquerque, N. Mex.

Procedures and firing conditions are described for the preparation of $BaTiO_3$ and lead titanate zirconate for studies on dielectric strength. The procedures were worked out for small batches and then scaled up for larger quantities required. The major effort was in the maintenance of purity and freedom from external contamination. (P.C.H.)

22907 (TID-23793) DIELECTRIC STRENGTH AND FERROELECTRIC BEHAVIOR OF CERAMICS. Quarterly Progress Report No. 3, August 1, 1963–November 1, 1963. (Rutgers–The State Univ., New Brunswick, School of Ceramics). Contract AT(29-1)-789. 40p. Dep. mn. CFSTI $3.00 cy, $0.65 mn.

For Sandia Corp., Albuquerque, N. Mex.

Hot pressing and firing techniques worked out for the fabrication of $BaTiO_3$ and lead titanate zirconates were tested. A large number of firings were performed on $BaTiO_3$ and lead titanate zirconate and hot pressing was performed on lead titanate zirconate. From the results it was found that the techniques used for preparing $TaTiO_3$ gave good ceramics and were better than for the other materials and processes. However, a system allowing the economical preparation of lead titanate zirconate materials, either by conventional firing or by hot pressing, was not developed. An unusual effect of grain growth was found to occur on $BaTiO_3$ fired above a certain critical temperature. (P.C.H.)

22908 (WCAP-3791-2) URANIUM PLUTONIUM CARBIDE DEVELOPMENT. Quarterly Progress Report for the Period Ending December 31, 1966. (Westinghouse Electric Corp., Pittsburgh, Pa. Advanced Reactors Div.). Feb. 1967. Contract AT(30-1)-3791. 34p. Dep. mn. CFSTI $3.00 cy, $0.65 mn.

Developments in the design and characterization of a (U,Pu)C fuel element that is suitable for application in a commercial, liquid metal-cooled, fast breeder reactor are reported. Methods for Fe and $Cr_{23}C_6$ stabilization of hypostoichiometric UC were identified, and stabilized and unstabilized (U,Pu)C pellets were fabricated, characterized, and tested. A detailed survey of stainless steel properties concluded with the current selection of Type 316 as reference fuel cladding material and Type 304 as alternate. The compatibility of Va alloys with carbide and oxide fuels was investigated. Conceptual design of test capsules was also begun. A preliminary demonstration of fuel element Na bonding by a bottom filling technique was completed. (P.C.H.)

22909 PRODUCTION OF SPHERICAL FUEL PARTICLES FROM AQUEOUS METAL-SALT SOLUTIONS. Bildstein, H.; Knotik, K. (Oesterreichische Studiengesellschaft fuer Atomenergie GmbH, Vienna). Kerntechnik, 9: 57-62(Feb. 1967). (In German).

The method described for the preparation of spherical particles of carbides or mixed carbides starting from solutions of metal salts was developed for a shorter and more economic refabrication of recycled or partly spent fuel. It is shown that the method can be widely applied and that real solutions and colloidal sols can be processed. If proper equipment is provided small samples and production-type quantities can be produced. By variation of the conditions during the carburization and melting process an improvement of the properties of carbide kernels was obtained. Their technological effects are under investigation. (auth)

Properties Evaluations

Refer also to abstracts 21858, 22873, 22902, 22908, 22927, 22931, and 22932.

22910 (LA-3646) THE USE OF (U, Pu)N FUEL WITH A SODIUM BOND: A SUMMARY OF EXISTING DATA. Thamer, B. J. (Los Alamos Scientific Lab., N. Mex.). Jan. 6, 1967. Contract W-7405-eng-36. 12p. Dep. mn. CFSTI $3.00 cy, $0.65 mn.

The pertinent literature is reviewed for an experimental study of the nuclear fuel (UN–PuN) bonded with Na to a suitable clad. Sections on the fuel's physical properties, mechanical properties, compatibility, and resistance to reactor radiation are followed by a discussion on outstanding problems that still exist. (53 references.) (auth)

22911 (NASA-TN-D-3898) ESTIMATING THERMAL CONDUCTIVITY OF CERMET FUEL MATERIALS FOR NUCLEAR REACTOR APPLICATION. Miller, John V. (National Aeronautics and Space Administration, Cleveland, Ohio. Lewis Research Center). Apr. 1967. 30p. CFSTI.

Several analytical methods that can be used to predict the thermal conductivity of cermet fuel materials were examined, and each was found to be valid over certain ranges. Some of the work being done on cermet fuels, however, is in a region that is not specifically covered by any of the models. Because of the similarity between two of the analytical models, a method that, in essence, allows extrapolation into this undefined region is suggested. Comparison with available experimental values showed that the suggested method results in favorable predictions and could, therefore,

be used to estimate the thermal conductivity of potential cermet fuel materials. Data were then generated by this method to illustrate the thermal conductivity behavior of a typical cermet fuel ($W-UO_2$) under various conditions. (P.C.H.)

22912 (TID-23791) DIELECTRIC STRENGTH AND FERROELECTRIC BEHAVIOR OF CERAMICS. Quarterly Progress Report No. 1, January 28, 1963–May 1, 1963. (Rutgers–The State Univ., New Brunswick. School of Ceramics). Contract AT(29-1)-789. 54p. Dep. mn. CFSTI $3.00 cy, $0.65 mn.

For Sandia Corp., Albuquerque, N. Mex.

Studies were made on the factors causing relatively low energy storage in ferroelectric ceramics with the use of novel shapes and test procedures. Statistical methods are discussed for use in studying the dielectric strength behavior of ceramics by isolating mechanisms and reducing the number of tests required. Experiments will be performed on $BaTiO_3$ and lead titanate zirconate. (P.C.H.)

22913 (TID-23794) DIELECTRIC STRENGTH AND FERROELECTRIC BEHAVIOR OF CERAMICS. Final Report, January 28, 1963–June 30, 1964. (Rutgers–The State Univ., New Brunswick. School of Ceramics). Contract AT(29-1)-789. 143p. Dep. mn. CFSTI $3.00 cy, $0.65 mn.

For Sandia Corp., Albuquerque, N. Mex.

Lead zirconate titanate and $BaTiO_3$ ceramics were prepared using high purity materials and methods for homogeneity. Firing techniques were used for maximum density and uniformity. The samples were shaped and electroded with a contour on one side such that there was a center area having a uniform field, and the edge had a reduced gradient. Ferroelectric and dielectric strength tests were performed using controllable dc fields. The dielectric strength data were plotted using a number of statistical models, and it was found that a good fit was obtained with a skewed or extreme value distribution. This is related to a weak-link physical model of failure, and indicates that the breakdown is dependent on flaws in the ceramic. Dissection of the samples revealed gross flaws and imperfections. (auth)

22914 SOLID SOLUTION OF BORON IN GRAPHITE. Lowell, C. E. (Union Carbide Corp., Parma, Ohio). J. Amer. Ceram. Soc., 50: 142-4(Mar. 21, 1967).

The solubility of B in graphite was determined in the temperature interval of 1800° to 2500°C. The maximum solubility was 2.35 at. % at 2350°C; the solution was found to be substitutional. (auth)

22915 USE OF A SIMPLE SMALL-ANGLE SCATTERING DEVICE TO DETERMINE PARTICLE SIZE DISTRIBUTION OF THORIA SOLS. Stoecker, W. C. (Mallinckrodt Chemical Works, St. Charles, Mo.). Anal. Chem., 39: 628-32(May 1967).

A simple small-angle scattering device attached to a commercial diffractometer was used for the examination of thoria sols. A study is made of collimation errors inherent in the device, with particular reference to its ability to resolve scattered rays whose angles with respect to the direct beam are not widely separated. This study showed that simple equipment of low resolution is adequate for a system of particles having a scattering curve that can be approximated by a Gaussian function or a composite of several Gaussian functions. Each thoria sol examined produced a small-angle scattering curve having its own characteristic shape that was unchanged by dilution or instrument factors. The small-angle scattering data were used to determine particle size distribution through the use of a well-known graphical method. The average particle diameter (on a volume per cent basis) calculated from the size distribution analysis was found to agree with the mean crystallite size as determined by line broadening. (auth)

22916 INCORPORATION OF IONS IN ANODIC OXIDE FILMS ON ZIRCONIUM AND THEIR EFFECT ON FILM BEHAVIOR. Banter, J. C. (Oak Ridge National Lab., Tenn.). J. Electrochem. Soc., 114: 508-11(May 1967). (ORNL-P-2496).

Transmission spectra of anodically formed ZrO_2 films showed that certain anions such as phosphate, sulfate, and several carboxylates are incorporated in these films when they are formed in solutions containing these ions. Furthermore, hydrous ZrO_2 films result from anodizing in strongly oxidizing electrolytes. Films formed in many other solutions contain no incorporated ions. Film conductivity and thickness measurements indicated that incorporated ions increase the electrical resistance of the films, as well as limit their growth. It is suggested that these effects arise from lowered rates of diffusion of electrons and oxygen ions through the films and that the lowered diffusion rates result from the space charge created by the incorporated ions. (auth)

22917 REFRACTORY CHARACTER OF CUBIC SOLID SOLUTIONS FORMED BY ZIRCONIA WITH CERTAIN SESQUIOXIDES OF RARE EARTHS. Foex, Marc; Rouanet, Alain (CNRS, Montlouis, France). Compt. Rend., Ser. C, 264: 947-50 (Mar. 13, 1967). (In French).

ZrO_2 forms with the sesquioxides of the rare earths of the Y group cubic solid solutions sometimes showing a refractory property superior to that of the base oxide. Also studied was the influence of various sesquioxides on the tetragonal $\rightleftharpoons$ cubic transformation temperature shown by ZrO_2 at high temperature. (tr-auth)

22918 UO_2 THERMAL DIFFUSIVITY MEASUREMENTS WITH A MODULATED ELECTRON BEAM TECHNIQUE. Serizawa, Mitiya; Inoue, Kiyoshi; Taniguchi, Kaoru (Hitachi Ltd., Tokyo). J. Nucl. Sci. Technol. (Tokyo), 3: 550-1(Dec. 1966).

The thermal diffusivity of $UO_{2.00}$ (91% theoretical density) was measured by heating plate specimens with a sine wave-modulated electron beam. Temperatures covered 1200 to 1600°K. The thermal conductivity values agree fairly well with reported values. (D.L.C.)

22919 REGULARITIES IN THE THERMAL PROPERTIES OF VARIOUS OXIDES. Malakhov, Ya. S.; Samsonov, G. V. (Inst. of Metallurgy, Kiev. Inst. of Problems in Studies of Solids, Kiev). Izv. Akad. Nauk SSSR, Neorg. Mater., 2: 2162-7(Dec. 1966). (In Russian).

Tabulated data are given on the electronic structure of isolated atoms of transition metals and on the thermal stability and melting points of oxides formed by these (Sc, Ti, V, Cr, Mn, Fe, Co, Ni, Y, Zr, Nb, Mo, Tc, Ru, Rh, Pd, La, Hf, Ta, W, Re, Os, Ir, and Pt) metals. It is shown that the thermal stability and melting point of the oxides are determined by the component valent electron distribution as localized and nonlocalized electrons and by formation of stable electron configurations by the transition metal and oxygen atoms. Reduced statistical weight of stable configurations and increased portions of nonlocalized electrons resulted in a reduced melting point temperature and reduced thermal stability. (R.V.J.)

22920 USE OF SPHERICAL UO_2 IN A CERMET FUEL PLATE. Robertshaw, F. C.; Betts, R. K.; Conner, D. E. (General Electric Co., Evendale, Ohio). Nucl. Sci. Eng., 28: 20-33(Apr. 1967).

Efforts were made to use plasma-spheroidized UO_2 particles in the preparation of a $UO_2-Ni-Cr$ alloy cermet fuel plate. Mechanical property data were obtained permitting property comparisons between the plate containing plasma-spheroidized fuel and other types of fueled and unfueled plates. The plate containing spherical fuel possessed significantly better ductility and somewhat more consistent properties than other fuel plates tested. The results of an irradiation experiment with the plate containing spheroidized fuel showed its performance to be equivalent to the best of those for which data have been published; however, further testing is required to establish whether a definite superiority exists. (auth)

22921 PERFORMANCE OF PYROLYTIC CARBON-COATED URANIUM OXIDE PARTICLES DURING IRRADIATION AT HIGH TEMPERATURE. Reagan, P. E.; Beatty, R. L.; Long, E. L. Jr. (Oak Ridge National Lab., Tenn.). Nucl. Sci. Eng., 28: 34-41 (Apr. 1967). (ORNL-P-2067).

The performance of pyrolytic C-coated, high-density, UO_2 particles irradiated at 1300 to 1600°C was studied. The fission-gas release, burnups, and temperatures for five experiments are given. Coated particles with a built-in gap between the fuel and the inner laminar coating began to show evidence of failure by releasing bursts of fission gas after 27.9% U burnup, and postirradiation examination revealed delamination of the inner coating. Coated particles made with a porous C buffer layer between the fuel and an isotropic coating showed no evidence of failure by fission-gas release, and showed no damage due to irradiation when examined by metallography. Coated particles with neither gap nor buffer, but with a low-density inner coating applied directly to the fuel, retained fission gas successfully but showed enlargement of cracks that had formed at the fuel-coating interface during the coating process. The oxide particles did not flow at high burnup and expand into voids and cracks as the carbide particles did, and the oxide did not diffuse into the C coating at high temperatures. (auth)

22922 COMPATIBILITY OF GRAPHITE WITH CESIUM. Salzano, F. J.; Aronson, S. (Brookhaven National Lab., Upton, N. Y.). Nucl. Sci. Eng., 28: 51-4(Apr. 1967). (BNL-10251).

A method is presented for predicting the conditions under which graphite will react with Cs at high temperatures and low Cs pressures to form compounds. The method is based on the available thermodynamic data on Cs–graphite compounds and on an understanding of the nature of the bonding forces in these compounds. An expression is given for the threshold pressure, at any temperature, below which no reaction will occur between Cs and graphite. The structural deterioration and swelling of graphite which occurs when Cs–graphite compounds are formed can be avoided by keeping the Cs pressure below the threshold value. The information on the compatibility of Cs and graphite is of potential use in the design of MHD direct-conversion systems, in high-temperature graphite

reactors and in systems that require the availability of Cs vapor at controlled pressures, such as thermionic converters. (auth)

22923 X-RAY ANALYSIS OF STRAIN AND CRYSTALLITE SIZE IN TUNGSTEN CARBIDE COMPRESSED AT HIGH PRESSURE. Kudakaba, Katsuya (Mitsubishi Metal Mining Co., Obmiya, Japan). Trans. Jap. Inst. Metals, 7: 296-7(Oct. 1966).

The x-ray line broadening of WC subjected to high pressure of 5 to 40 kbar was investigated. With increasing pressure the strain increased and the crystallite size decreased, but they gradually approached constant values. Studies were also made on WC annealed at temperatures of 800 to 1200°C after being subjected to 40 kbar. Generally with increasing annealing temperature, the strain decreased and the crystallite size increased. However, since grain growth was not significant between 800 and 1200°C, annealing in this temperature range had a greater effect on the removal of strain than on crystal growth. (J.G.B.)

22924 METAL–BERYLLIUM OXIDE SEAL AND ITS UTILIZATION IN SEMICONDUCTORS. Dubee, A. (Compagnie Francaise Thomson-Houston, Bagneux, France). Vide, 21: 433-6(Nov.-Dec. 1966). (In French).

Sintered BeO possesses the usual properties of mechanical strength, dielectric strength, and insulation common to sintered pure ceramic oxides. Moreover, it also has an excellent refractoriness and a very high thermal conductivity. In order to reduce as much as possible the effect of thermal contact resistance at the metal–BeO connection and, furthermore, to obtain a tight joint, it is necessary, first of all, to metallize the BeO and then, to solder or braze it to the metallic parts with which it forms a leakproof chamber or a thermal conduction heat transfer system. BeO was applied to the manufacture of leakproof electron tube chambers, cooled delay lines, and other devices requiring good dielectrical properties and high thermal conductivity. Another field of application for this material, because of the two properties previously indicated, is that of semiconductor devices; e.g., transistor bases, power diode packages, etc. (auth)

22925 TECHNICAL PROPERTIES OF COMPOSITIONS OF THE MgO–Cr_2O_3–ZrO_2 SYSTEM. Klyucharov, Ya. V.; Kral', O. A. (Leningrad Inst. of Tech.). Ogneupory, No. 1, 55-60 (Jan. 1967). (In Russian).

The technical properties of compositions containing MgO in amounts enough to completely bond Cr_2O_3 into $MgCr_2O_4$ and to stabilize ZrO_2 were studied. The ultimate compression strength, apparent density, apparent porosity, temperature of deformation under stress, linear setting, and chemical stability with respect to CaO and Fe_2O_3 were determined for seven specimens of MgO–Cr_2O_3–ZrO_2 refractories of different composition. The specimens were obtained by sintering mixtures of dry (at 120°C) uncalcined ZrO_2, calcined (at 1300 and 1600°C) MgO, and $MgCr_2O_4$. The latter was obtained by sintering mixtures of pure MgO and Cr_2O_3 at 1400 and 1750°C. Composition of the refractories before and after firing are given. Analysis of the experimental data showed that dense, chemically and mechanically stable specimens of the MgO–Cr_2O_3–ZrO_2 system, which have a high deformation temperature (above 1720°C) under load (2 kg/cm^2) may be obtained from mixtures containing uncalcined ZrO_2, $MgCr_2O_4$, and MgO (calcined at 1600°C) with the final firing temperature of the refractory at 1700 to 1750°C. The addition of ZrO_2 to spinellide–periclase compositions increased their density and chemical stability with respect to CaO; the addition of $MgCr_2O_4$ improved their stability with respect to iron oxides. (ATD)

Structure and Phase Studies

Refer also to abstracts 21860 and 22923.

22926 (NP-16686) STUDIES OF CERAMIC PROCESSING. Final Report, December 1, 1964–December 15, 1965. Smoke, E. J.; Ringel, C. M.; Fleischner, P. L. (Rutgers-The State Univ., New Brunswick, N. J. School of Ceramics). Contract NOw-65-0199-d. 73p. CFSTI.

The improvement of ceramic structures by processing was investigated. The over-all temperature range of interest was 1800 to above 3000°F. In the high portion of the range, 3000°F and above, compositions of pure Al_2O_3 plus 0 to 2% additions of MgO were studied between 2822 and 3180°F, at 1 to 7 hour soaking periods and in atmospheres of H_2, He, and vacuum. Petrographic, x-ray, dc conductivity, electron transmission, and electron probe methods were used and the results are reported. The second temperature range, 2600 to 3000°F, was studied utilizing the presintered approach to the prereacted raw materials technique. The low range, 1800 to 2600°F, was studied using the devitrification approach to the prereacted materials technique. The area of crystallization of cordierite in the MgO · Al_2O_3 · SiO_2 system was evaluated as a single glass system. A two-glass system, in which one glass devitrifies cordierite and the second supplies the bonding system, was studied. Bonding glass compositions were evaluated in the RO · Al_2O_3 · SiO_2 system, in which the RO members are alkaline earth oxides. Composites were made at 10, 20, and 30% bonding glass. Processing, structures, and properties are reported. (auth)

22927 (ORNL-TM-1772) COATED-PARTICLE FUELS DEVELOPMENT AT OAK RIDGE NATIONAL LABORATORY FOR PERIOD MAY 15, 1966–JANUARY 15, 1967. Coobs, J. H.; Sisman, O. (comps.) (Oak Ridge National Lab., Tenn.). Mar. 1967. Contract W-7405-eng-26. 71p. (CONF-670311-1). Dep. mn. CFSTI $3.00 cy, $0.65 mn.

From 12th AEC Coated-Particle Working Group Meeting, Las Vegas, Nev.

Developments are reported for studies on graphite-base fuel concepts involving pyrolytic-C-coated fuel particles for gas cooled civilian power reactor application. Major emphasis has continued on the testing and evaluation of pyrolytic-C-coated oxide fuel particles. The mathematical model for coated-particle behavior was modified to include the effects of radioinduced creep and is being used to guide the irradiation program and to correlate results from irradiation experiments. Developments are also reported for pyrolytic C coating studies, out-of-reactor characterization of coated particles, irradiation testing, and post-irradiation examination. (P.C.H.)

22928 PHASE RELATIONS IN THE SYSTEM FeO–Fe_2O_3–ZrO_2–SiO_2. Jones, T. S.; Kimura, Shigeyuki; Muan, Arnulf (Pennsylvania State Univ., University Park). J. Amer. Ceram. Soc., 50: 137-42(Mar. 21, 1967).

Phase equilibrium relations in the liquidus-temperature region of the system, FeO–Fe_2O_3–ZrO_2–SiO_2, in air were delineated by the quenching technique. Additional equilibration runs were made at other controlled O_2 pressures as well as in sealed containers. The results of all runs were combined with literature data for the system in contact with metallic iron to locate approximately the quaternary liquidus invariant points within the system FeO–Fe_2O_3–ZrO_2–SiO_2. (auth)

22929 PHASE EQUILIBRIUM IN THE SYSTEM PbO–TiO_2–ZrO_2. Fushimi, Shoichi; Ikeda, Takuro (Nippon Telegraph and Telephone Public Corp., Tokyo). J. Amer. Ceram. Soc., 50: 129-32(Mar. 21, 1967).

Phase equilibrium relations in the system PbO–TiO_2–ZrO_2 were studied by quenching in the range where the PbO content is 50 mole % and more. Isotherms were examined at 1100, 1200, and 1300°C and tie lines were determined between the liquid and solid solution in equilibrium. The incongruent melting point of $PbZrO_3$ was 1570°C and the equilibrium between liquid, PbO-type solid, and $PbZrO_3$ was peritectic. $Pb(Zr,Ti)O_3$ solid solutions containing more than 14 mole % $PbZrO_3$ decomposed to liquid, ZrO_2, and $Pb(Zr,Ti)O_3$ and the decomposition temperature rose from 1340 to 1570°C with increasing $PbZrO_3$ content. The system $PbTiO_3$–$PbZrO_3$ should not be treated as a binary, but as a section of the ternary system. (auth)

22930 MOLECULAR SIZE PORES IN BERYLLIUM OXIDE POWDERS. Horlock, R. F.; Anderson, P. J. (Atomic Energy Research Establishment, Harwell, Eng.). Trans. Faraday Soc., 63: 717-26(Mar. 1967). (AERE-R-5379).

BeO, prepared by thermal decomposition of β-$Be(OH)_2$ in vacuo, consisted of porous aggregates of crystallites ~30 Å. The aggregates were relics of individual hydroxide crystals, which undergo a volume shrinkage on decomposition of only ~30% of theoretical and have a density ~50% that of dense BeO. Of the intra-aggregate pore volume, only ~20% was available to CCl_4 and ~50% to N_2 and there was a substantial volume of pores < ~6 Å and < ~3 Å. Such small pores rendered surface-area measurement from gas adsorption meaningless, caused a small irreversibility in N_2 adsorption at low pressures, and caused measurable He adsorption even at 100°C. Although of comparable molecular size to N_2, water molecules were able to penetrate most or all of the pores (due to the higher interaction energy of H_2O with the oxide surface) and after desorption some of these became accessible to N_2. Similarly water adsorption and desorption increased the pore volume accessible to CCl_4, and various water treatments (including decomposition of the hydroxide in the presence of water vapour) led to a microstructure in which pores < ~6Å are virtually absent. (auth)

22931 PROPERTIES OF ZIRCONIUM DIBORIDE–MOLYBDENUM ALLOYS. Kislyi, P. S.; Kuzenkova, M. A. (Inst. of the Problems of the Science of Materials, Novosibirsk, USSR). Izv. Akad. Nauk SSSR, Neorg. Mater., 2: 2139-44(Dec. 1966). (In Russian).

ZrB_2 powder, containing 80.0% Zr, 18.90% B, 0.56% Cu and 0.11% Fe, was mixed with 5, 10, or 15% of 99.99%-pure Mo powder and compacted into ingots which were sintered in an Ar atmosphere at

2000 to 2100°C for 2.5 to 3 hr, furnace cooled to 1200 to 1400°C, and finally cooled in a stream of Ar. X-ray diffraction patterns showed that the sintered alloys consisted of a solid solution of Mo in ZrB_2, and (depending on Mo content) 6.13, 6.21, or 6.27 mol % of ZrB formed from ZrB_{12} present in the ZrB_2 powder. The solid solution of Mo in ZrB_2 in the alloys corresponded to the formulas: $(Zr_{0.952}Mo_{0.048})B_{1.72}$, $(Zr_{0.902}Mo_{0.098})B_{1.47}$, and $(Zr_{0.841}Mo_{0.159})B_{1.35}$. The alloys had a respective microhardness of 2082 ± 120, 1860 ± 140, and 1470 ± 200 dan/mm². The microhardness of ZrB_2 and ZrB in all alloys was 2250 ± 100 and 3570 ± 250 dan/mm², respectively. Alloys with 5, 10, and 15% Mo extruded and sintered at 2200°C had a porosity of 5.5 to 6.2, 6.8 to 7.5 and 10.2 to 13.1%, respectively, and an oxidation rate significantly lower than that of pure ZrB_2. In thermal shock resistance tests (water quenching from 1200°C) the alloys with 5, 10, and 15% Mo sustained 8 to 12, 8 to 12, and 10 to 16 cycles, respectively, compared with 2 to 4 cycles for ZrB_2. (ATD)

22932 INVESTIGATION OF SOME PHYSICAL PROPERTIES OF HfC–MoC AND TaC–MoC SOLID SOLUTIONS. Shulishova, O. I.; Shcherbak, I. A. (Inst. of the Problems of the Science of Materials, Novosibirsk, USSR). Izv. Akad. Nauk SSSR, Neorg. Mater., 2: 2145-50(Dec. 1966). (In Russian).

HfC–MoC alloys and TaC–MoC alloys, both with a MoC content of 0 to 100 mol %, were synthesized from a mixture of HfO_2, TaC, Mo powders, and carbon black. The mixtures were hot compacted at 2000 to 2200°C for 15 min. The sintered bars were vacuum annealed at 2000°C for 1 to 2 hr and slowly cooled. All alloys were found to be homogeneous single-phase solid solutions with a free C content of less than 0.5%. The dependence of the temperature of transition to the superconducting state (T_{cr}), melting temperature, resistivity, microhardness, and lattice constant on composition or valency electron concentration is shown. The $(HfC)_{0.90}(MoC)_{0.10}$ and $(HfC)_{0.85}(MoC)_{0.15}$ alloys have a melting temperature higher than 3900°K, which makes them the most refractory in the investigated systems. The obtained results also show that in solid solutions of the IV and V group metal carbides with WC, the most refractory compounds should be sought in the region of electron concentrations of about 4.2 valence electrons per atom. The alloys of the HfC–WC system should have the highest melting temperature. Compounds with high T_{cr} temperatures should have an electron concentration of 4.8 to 4.9 valence electrons per atom. (ATD)

22933 REACTION OF SCANDIUM OXIDE WITH TUNGSTEN TRIOXIDE. Fedosov, V. N.; Nadol'skii, A. P.; Dontsova, V. I.; Liopo, V. A. (Irkutsk Polytechnic Inst., USSR). Izv. Vyssh. Ucheb. Zaved., Tsvetn. Met., No. 6, 94-6(1966). (In Russian).

It was found that Sc mixed with WO_3 at 1180°C formed $Sc_2O_3 \cdot 3WO_3$ composition. When the $Sc_2O_3 : WO_3$ molecular ratio exceeded 1 : 3 the sintered product contained free Sc_2O_3 in addition to $Sc_2O_3 \cdot 3WO_3$. With the molecular ratio below 1 : 3 it contained free WO_3. Formation of the $Sc_2O_3 \cdot 3WO_3$ system took place at 840°C. (R.V.J.)

Radiation Effects

Refer also to abstracts 21919, 22895, 22905, 22910, 22920, and 22927.

22934 (BNWL-366) THE IRRADIATION BEHAVIOR OF UO_2–PuO_2 FUELS IN PRTR. Freshley, M. D.; Panisko, F. E. (Battelle-Northwest, Richland, Wash. Pacific Northwest Lab.). Mar. 1967. Contract AT(45-1)-1830. 27p. Dep. mn. CFSTI $3.00 cy, $0.65 mn.

The irradiation behavior of full-sized, UO_2-PuO_2 fuel elements was investigated under power reactor conditions in the Plutonium Recycle Test Reactor (PRTR) at Pacific Northwest Laboratory to obtain information related to Pu utilization in thermal reactors. Vibrationally compacted UO_2-PuO_2 fuel structures change significantly when irradiated at rod powers of 20 kW/ft with centerline fuel temperatures near melting. The major changes in fuel structure occurred rapidly; whereas, time-temperature dependent sintering effects caused the fuel sintering radius to increase with exposure. In reactor homogenization and solid-solution formation by UO_2 and PuO_2 interdiffusion commenced in pneumatically impacted, physically mixed UO_2-PuO_2 fuel at temperatures sufficient to cause sintering. Fuel melting, as evidenced by the formation of a well-defined region composed of a cellular appearing structure in the thermal center of the rod, commenced in vibrationally compacted (86% TD) UO_2-2 wt % PuO_2 fuel rods at 20 to 21 kW/ft under PRTR operating conditions. The results show that the power to produce melting in vibrationally compacted fuel is ~20% less than for sintered pellet fuel. Examination of fuel structures formed during irradiation in long continuous vibrationally compacted fuel rods suggests that radial and axial fuel relocation occurs under molten core conditions. Generally, the defect behavior of packed-particle fuel rods was excellent. Fission product migration during irradiation in vibrationally compacted UO_2-PuO_2 fuels was similar to that observed in irradiated UO_2 fuels. Fission gas release results showed a maximum of 92% Xe + Kr release from rods that operated with volumetric average fuel rod temperatures of ~2200°C, produced by a maximum rod power of 27 kW/ft in PRTR. (P.C.H.)

22935 (GA-7171) DESCRIPTION AND RESULTS OF THE P10 COATED PARTICLE IRRADIATION EXPERIMENT. Luby, C. S. (General Dynamics Corp., San Diego, Calif. General Atomic Div.). July 21, 1966. Contract AT(04-3)-167. 50p. Dep. mn. CFSTI $3.00 cy, $0.65 mn.

Twelve types of coated fuel particles were irradiated to 9 to 16% burnup (FIMA) at temperatures of 950 to 1700°C (average = 1330°C) in Capsule P10. The fast flux exposure was 7.0×10^{20} nvt (E > 0.18 MeV). Postirradiation examination indicated that the stability of isotropic pyrolytic carbon coatings increased with increasing coating density and that small fuel particles had greater stability than large particles (with constant coating-thickness to fuel-particle-diameter ratio). (auth)

22936 (NP-16609) COMPORTEMENT SOUS IRRADIATION NEUTRONIQUE DE QUELQUES VARIETES DE SILICE VITREUSE. IRRADIATIONS L. 60 ET M. 60. (Behavior Under Neutron Irradiation of Some Forms of Vitreous Silica. Irradiations L. 60 and M. 60). Labbe, C. (Commissariat a l'Energie Atomique, Saclay (France). Centre d'Etudes Nucleaires). July 1964. 42p. (In French). (DM-1391). Dep. mn.

Samples of three varieties of vitreous silica were irradiated in Westinghouse testing reactor at a dose of 1.5×10^{21} n/cm² with neutron energy above 1 MeV at 100 and 350°. The principal effects observed were an increase in density of 1.2% at 350°C and of 2.4% at 150°C, an increase of the Young modulus of 3.6%, and an increase of the mechanical resistance of 5% at 350°. Annealing at 1,000°C of the irradiated samples caused simultaneously significant fragilization and the appearance of devitrified zones in which the presence of α crystobalite was established. (tr-auth)

22937 (TID-23665) PERFORMANCE OF UO_2 FUEL WITH CENTRAL MELTING. Weidenbaum, Bernhardt; Lyons, Mark F.; Pashos, Thomas J. (General Electric Co., Pleasanton, Calif. Vallecitos Nuclear Center). Nov. 16, 1966. Contract AT(04-3)-540. 18p. Dep. mn. CFSTI $3.00 cy, $0.65 mn.

The irradiation of capsules and rods at incremental heat fluxes in the range from 190 to 440 W/cm² ($0.6-1.4 \times 10^6$ Btu/hr-ft²) provided the original basis for utilizing UO_2 as a molten fuel and evaluating experimentally the possible problem areas that could impose an operating limit with this mode of fuel operation. The feasibility of using UO_2 as a fuel with a portion of it in the molten state was demonstrated by the irradiation of a four-rod assembly to a significant burnup at a specific power of 37 kW/ft in a pressurized loop. The rods had a fuel geometry of interest for power reactors with bulk UO_2 and Zr-2 cladding. Two rods with vibratory compacted, arc-fused powder attained a burnup of 6×10^{20} fissions/cc and two rods loaded with cored pellets a burnup of 3×10^{20} fissions/cc. Attainment of higher heat fluxes, and thereby the program goal of obtaining the operating limit of UO_2 as a fuel, was not possible because of operational limitations of the loop. The extent of fuel swelling in solid pellets whose density was approximately 95 per cent was found to vary linearly with the amount of fuel that was molten. The value for fission gas release approached a limit of sixty per cent at the highest power levels in fuel with relatively low burnup. The fission gas release data were used to obtain numerical coefficients in a general equation that describes a proposed fission gas release model based on the temperature distribution in the fuel. Virtually complete release was obtained from the powder fuel irradiated to the highest burnup because of long-term structural changes in the UO_2 adjacent to the cladding. In the instances that cladding failure occurred, molten fuel interaction with the cladding and release of fuel to the coolant was slight. (P.C.H.)

22938 EFFECT OF LOW-DOSE REACTOR RADIATION ON THE DYNAMIC MECHANICAL BEHAVIOR OF PYROLYTIC GRAPHITE. Brennan, J. J.; Kline, D. E. (Pennsylvania State Univ., University Park). Carbon, 5: 181-8(Apr. 1967).

The dynamic mechanical behavior of pyrolytic graphite (PG) (deposited at 2200°C) was investigated as a function of reactor radiation dose up to 1.8×10^{17} nvt (fast). Studies from 100 to 800°K at frequencies near 2000 c/s indicated that the dynamic modulus of as-received PG decreased over this temperature range by a few percent. A relaxation peak ($Q^{-1} \approx 10^{-3}$) appeared near 240°K. Irradiation to 1.8×10^{17} nvt (fast) resulted in a non-linear increase in modulus with dose to about 5.5% and in a pronounced modulus inflection near 240°K. Relaxation processes were also evident near 380 and 700°K in the irradiated samples. Upon retesting of irradiated samples which were exposed to temperatures of 700 to

800°K during the prior test runs, the modulus recovered to approximately as-received values, but the 240°K inflection anomaly became more prominent. Annealing studies indicated that the modulus recovery depends upon temperature and time. Exposure to high test temperatures appeared to eliminate the 380°K post-irradiation peak, but left the 700°K process almost undisturbed. The 380°K peak also disappeared with time at constant temperature (near 380°K). An attempt is made to interpret some of the experimental results, and to correlate the observations with irradiation effects in graphite as reported in the literature. (auth)

22939 THERMOLUMINESCENCE OF γ IRRADIATED ALUMOSILICATE GLASSES. Chervetsova, I. N.; Levi, N. I.; Dilung, I. I.; Grimalskii, N. P.; Goikhman, V. Yu. Zh. Prikl. Spektrosk., Akad. Nauk BSSR, 6: 411-13(Mar. 1967). (In Russian).

The intensity and spectrum of thermoluminescence of γ-irradiated glasses of $SiO_2 \cdot Al_2O_3 \cdot Na_2O$ and $SiO_2 \cdot Al_2O_3$ were found to depend on the glass composition. Data were obtained on the change of transmission spectra by integral dose increase, as well as by thermal bleaching of the irradiated samples. (TSS)

22940 ELECTRON MICROSCOPIC OBSERVATION OF THE CLEAVAGE OF THE BASE PLANES IN BERYLLIUM OXIDE IRRADIATED IN REACTORS AT HIGH DOSES. Bisson, André; Elston, Jean; Frisby, Henri (CEN, Saclay, Gif-sur-Yvette, France). Compt. Rend., Ser. B, 264: 67-9(Jan. 4, 1967). (In French).

In BeO irradiated at 1,100°C at a dose of $7 \times 10^{21} n_r/cm^2$ a type of cleavage on the base plane was found that is very rare in slightly irradiated samples. This phenomenon was attributed to the very high density of dislocations coming from the segregation of point faults on the [00.1] planes, which leads to the hypothesis of a mechanism for the microfissioning of BeO frits irradiated at high temperature. (tr-auth)

22941 IRRADIATION INDUCED PLASTICITY IN GRAPHITE UNDER CONSTANT STRESS. Gray, B. S.; Brocklehurst, J. E.; McFarlane, A. A. (United Kingdom Atomic Energy Authority, Culcheth, Eng.). Carbon, 5: 173-80(Apr. 1967). (TRG-Report-1071).

The irradiation-creep behavior of graphite was studied in the reactor BR-2 at Mol, Belgium, up to fast neutron doses of 5×10^{21} n/cm^{-2} within the temperature range from 300 to 500°C. Results are presented for graphites irradiated under constant uniaxial compressive and tensile loads. The graphites studied include the normal Pile Grade "A" and a number of improved graphites being considered for future nuclear power reactors. It is shown that the presence of an applied stress greatly modifies the irradiation induced dimensional changes up to high doses, and that the graphites are capable of absorbing large creep strains without failure. In addition it was found that the stress also modifies the thermal expansion coefficient of irradiated specimens. (auth)

Plastics and Other Materials

Refer also to abstracts 21860 and 23258–23260.

22942 (COO-1477-7) DEVELOPMENT OF TEST PROCEDURES. FRACTURE TOUGHNESS OF REACTOR PRESSURE VESSEL STEELS, Period Covered: November 1, 1966–January 31, 1967. Ripling, E. J.; Crosley, P. B. (Materials Research Lab., Inc., Richton Park, Ill.). Mar. 24, 1967. Contract AT(11-1)-1477. 12p. Dep. mn. CFSTI $3.00 cy, $0.65 mn.

Design features for evaluation of irradiation damage in terms of fracture toughness are described. With double cantilever beam (DCB) specimens contoured to $m = 3$ with $b = 1.00$ and $b_n/b = 0.75$ a single test, which would normally be inconclusive because of a failure to obtain valid plane strain fracture, can define a value of K_{Ic} which underestimates the plane strain fracture toughness of the material. Its practical significance requires that this lower limit of K_{Ic} occur at a realistic toughness level and/or that there be some satisfactory method of estimating the extent to which the toughness is underestimated. Measurements of K_{Ic} up to about 100 ksi $in.^2$ were obtained. This value is greater than the room temperature fracture toughness for the weakest orientation, but less than the toughness for other orientations. (P.C.H.)

22943 (RHEL/R-139) EFFECT OF RADIATION ON THE MECHANICAL PROPERTIES OF POLYETHYLENE TEREPHTHALATE FILMS. Morgan, J. T.; Sheldon, R.; Stapleton, G. B. (Rutherford High Energy Lab., Chilton (England)). Nov. 1966. 15p. Dep. mn. HMSO 2s. 6d.

The variation in mechanical properties with film thickness and the changes in these properties with radiation dose were determined. (auth)

22944 (TID-23683) THERMAL INSULATION DEVELOPMENT. Final Report. Speil, S. (Johns-Manville Research Center, Manville, N. J.). Dec. 22, 1952. Contract AT(36-1)-8. 22p. DTIE.

Rigid insulation of remarkably low thermal conductivity has been developed for use on mobile propulsion unit. Various formulations of this resin-bonded silica aerogel insulation (LK insulation) have a "k" value varying from 0.16 at a mean temperature of 300°F to 0.30 at 1000°F, depending on the type and amount of opacifier. Carbon black is the optimum opacifier for temperatures up to approximately 500°F; a mineral such as zircon is preferable for intermediate temperatures; and a metal such as silicon is best for higher temperatures up to 1300°C. The modulus of rupture varies from approximately 10 to 50 psi with density (10 to 16 pcf) and amount of binder (2 to 10 per cent) and/or reinforcing fiber such as Amosite (5 to 15 per cent). The resilient, cork-like insulation has better handleability than a more brittle material with a comparable measured strength. Although a resin binder is used in molding the insulation, the material has appreciable strength even after the bond is burned out. These insulations, including the media opacified with carbon black, can be rated as incombustible according to the Columbia Fire Curve (Commercial Standard CS 131-46). Resin bonded aerogel (LK insulation) appears to have good resistance to hot-humid atmospheres but will require protection from water splash. Sample LK insulation has been manufactured on a pilot plant basis for laboratory evaluation and simulated service tests on STR Mark I. The manufacturing process consists essentially of dry precision molding of a blend of four ingredients: silica aerogel, Amosite fiber, phenolic resin, and an opacifier. An initial cure under pressure at temperatures of 300 to 350°F for 15 to 30 minutes is required to retain the shape and permit handling of the molded section after it is removed from the mold. A final cure for 16 hours at 300°F insures maximum strength. It also includes application of an outside protective jacket of corrugated aluminum foil and an inner felt of Amosite fiber both bonded to the insulation. (auth)

PHYSICS (GENERAL)

Astrophysics

Refer also to abstracts 23011 and 23089.

22945 (AD-632166) SECULAR VARIATIONS IN THE MAGNETIC FIELD STRENGTH OF SUNSPOT GROUPS. Report No. Scientific-6. Ringnes, Truls S. (Oslo Univ. (Norway). Institutt for Teoretisk Astrofysikk). 1965. Contract AF 61(052)-743. 46p. (AFCRL-66-219). CFSTI.

The relation between area and magnetic field strength of sunspot groups, the magnetic life history of long-lived spots and frequency distribution of observed maximum field strength of sunspot groups were studied over the period 1917–1958. The secular variations which were detected are discussed and compared with the secular variations established previously in the number of sunspot groups, their areas, area distribution etc. Finally a brief account is given of the eighty-year cycle of sunspots. (auth)

22946 (AD-638192) NARROW BAND STUDIES OF SOLAR BURSTS. Report No. Scientific-8(57). Elgaroy, Oystein (Olso Univ. (Norway). Institutt for Teoretisk Astrofysikk). 1966. Contract AF 61(052)-743. 27p. (AFCRL-66-590). CFSTI.

A survey of results obtained with high-resolution radio spectrographs is given and some possible interpretations are indicated. (auth)

22947 (AD-643427) EFFECTS OF A LARGE MAGNETIC FIELD ON ENERGY TRANSFER IN WHITE DWARF STARS. Landstreet, John Darlington (Columbia Univ., New York). 1965. Contract AF 49(638)-1358. 148p. (AFOSR-66-2779). CFSTI $3.00 cy, $0.65 mn.

Thesis.

The study was concerned with possible effects of a large magnetic field (in the range of $\sim 10^6$ to $\sim 10^{13}$ gauss) on the transfer of thermal energy out of a white dwarf star. It is shown that a field at the surface of a white dwarf of approximately 200,000 gauss is sufficient to produce observable Zeeman splitting of spectral lines, but that when the surface field exceeds about 10^7 gauss, the sigma components of the Zeeman triplet are no longer visible and the line is simply weakened by the field. The possibility that a large surface field would result in significantly increased opacity through absorption by the inverse of the cyclotron radiation process is investigated, and it is shown that this "cyclotron opacity" would be unobservable except under special conditions. In a white dwarf, heat flow in the interior is carried almost entirely by degenerate electron conduction. It is shown that fields of the order of 10^9 or 10^{10} gauss result in substantial magneto-resistivity normal to the direction of the field, and some consequences of this effect for the surface radiation of a white dwarf are discussed. (auth)

22948 (N-67-15211) NEUTRINOS, HELIUM FLASH, AND WHITE DWARFS. Chiu, Hong-Yee (National Aeronautics and Space Administration, New York. Goddard Inst. for Space Studies). 1963. 7p. (NASA-TM-X-59255). CFSTI $3.00 cy, $0.65 mn.

The effect of neutrino processes in delaying or stopping helium burning (and carbon burning) in certain red giants is discussed. Previously derived equations for calculating the neutrino energy flux from the core of a red giant model are given. Since in the plasma neutrino process the energy loss rate increases as the density increases (and as the core mass increases), an equation is derived to give the lower limit for the increase in the core mass necessary to raise its temperature to the helium burning point. This equation is valid for red giants of solar masses from 0.7 to 1.3. It is pointed out that the same analysis may not be applied to a star just prior to the carbon burning stage because the neutrino flux is very large. (STAR)

22949 (N-67-15213) INITIAL VALUE PROBLEM FOR OSCILLATIONS OF THE INTERSTELLAR GAS. Lerche, I.; Parker, E. N. (Chicago Univ., Ill. Enrico Fermi Inst. for Nuclear Studies). Dec. 1966. 29p. (NASA-CR-81125; EFINS-66-111). CFSTI $3.00 cy, $0.65 mn.

For a simple model of the interstellar gas–magnetic field system, in which the disk population of stars provides most of the gravity, it is demonstrated that a dispersion relation approach to the problem of small perturbations of the equilibrium state leads to unstable modes which possess a constant energy density at an infinite distance from the disk. Since one normally treats perturbations in which the energy density vanishes at infinity, rather than merely being bounded, an initial value problem was investigated in which the energy density does vanish at infinity. In one simple case it is shown that an unstable situation can still develop but that the perturbed quantities grow linearly with time, rather than exponentially as a normal mode analysis would indicate. It is further shown that one can still characterize the time scale for instability by the free-fall time so that conclusions drawn elsewhere remain valid. (auth)

22950 (R-66SD-39) INTERNAL MAGNETIC FIELD OF THE SUN. Yen, K. T. (General Electric Co., Philadelphia, Pa. Missile and Space Div.). July 1966. 19p.

Analytical solutions for the internal magnetic field of the sun are presented. The solutions are based on the idea that the solar wind originates from the sun's interior. The magnetic field is assumed to be weak throughout the interior of the sun so that its effects on the general physical properties of the sun are small. The magnetogasdynamic equations are used to obtain the magnetic solutions. The general configuration of the magnetic lines given by the present solutions is found to be in agreement with that assumed by Babcock in his study of the sunspots and the 22-year solar cycle. A distinctive feature of the configuration is the presence of shallow submerged lines underneath the sun's surface. (auth)

22951 VARIATION OF THE SUNSPOT CYCLE. Nemeth, Tivadar. Geofiz. Kozlem., 16: 81-9(1967). (In Hungarian).

The existence and characteristics of the sunspot cycle are explained by means of conjunction with planets. It is shown that of the nine planets the interaction of the planetary triplet Venus-Earth-Jupiter plays the decisive role. The so-called narrow conjunction of the three planets occurs at time distances of 10.4 or 12.2 years. The average value of these, 11.2 years, agrees approximately with the length of the sunspot cycle. The variation of the cycle is caused by the planets' within a cycle approaching the conjunction with varying velocities. The velocity difference causes a stronger or weaker development of the sunspot activity in the individual cycles and also a lengthening or shortening of the cycle. (tr-auth)

22952 RED SHIFT AND VELOCITY OF RECESSION. McVittie, G. C. (Univ. of Illinois, Urbana). Ann. Inst. Henri Poincare, Sect. A, 5: 273-80(1966). (In French).

It is shown that the formula connecting red shift and velocity of recession in special relativity can be used in any model of the universe provided that the distance of the object and the time of emission of the radiation by which the object is seen are suitably defined. The theory is worked out in detail in the Einstein–de Sitter universe and in the de Sitter universe. (auth)

22953 AMPLIFICATION OF THE DIPOLAR MAGNETIC FIELD OF THE SUN BY DIFFERENTIAL ROTATION. Vostry, J. (Charles Univ., Prague). Bull. Astron. Inst. Czech., 18: 37-47(1967).

Chvojkova's model is computed not only for the solar surface, but for the whole sun, and in a manner that permits to dispensing with approximations. In addition to this model three others are examined with the field of an elementary dipole and coaxial cylindrical isorotation surfaces, and with the field of a dipole 0.5 R long for both types of isorotation surfaces. In the case of plane isorotation surfaces there exists the heliographic latitude φ_x which separates the equatorial (spot-forming) from the polar zone of solar activity. Thus Spörer's law is divided into two parts: the equatorial part explains the equatorwards migration of the spot-forming zone, the polar part the migration of the polar region of prominences. Spörer's law, however, gives no satisfactory description of the actual conditions in the spot-forming zone. In the case of cylindrical isorotation surfaces, latitude φ_x does not exist and Spörer's law is more in keeping with reality. However, it does not appear probable in any of these models that sunspots might form by emersion of the magnetic field from subphotospheric layers. (auth)

22954 PHYSICS OF RELATIVISTIC COLLAPSE. Novikov, I. D.; Zel'dovich, Ya. Nuovo Cimento, Suppl. (1), 4: 810-27 (1966).

The kinematics of spherically symmetric and asymmetric collapse are discussed. Physical processes at relativistic collapse are considered, including neutrino emission at the collapse of a cold star, neutrino emission by high-temperature plasma at the collapse of massive stars, accretion of matter by neutron and collapsed stars, and magnetic phenomena. The lagging-core model is investigated, and the equilibrium and collapse of a system of point masses interacting solely by gravitation are discussed. (W.D.M.)

22955 MAGNETIC UNIVERSE WITH MATTER. Khalatnikov, I. M. (Inst. of Theoretical Physics, Moscow). JETP Lett. (USSR)(Engl. Transl.), 5: 155-9(Mar. 15, 1967).

Translated from Zh. Eksp. Teor. Fiz., Pis'ma Redaktsiyu, 5: 195-200(Mar. 15, 1967).

Of astrophysical interest is the so-called cylindrical magnetic universe. In this stationary solution of the gravitational equations in vacuum, the magnetic field with cylindrical symmetry is determined completely by the metric of the space, and the metric is determined in turn by the energy–momentum tensor of the magnetic field. Such a solution in vacuum is stable against small perturbations. The absolute stability against arbitrary perturbations which do not violate the cylindrical symmetry has been demonstrated. Solutions of the magnetic-universe type in the presence of uncharged matter described by an equation of state $p = x\epsilon$ are considered. (W.D.M.)

22956 UPPER LIMITS TO THE HARD X-RAY FLUX FROM THE QUIET SUN AND JUPITER. Edwards, Paul J.; McCracken, K. G. (Southwest Center for Advanced Studies, Dallas). J. Geophys. Res., 72: 1809-12(Apr. 1, 1967).

The results of a survey of celestial sources of x rays with energies in the range 20 to 60 keV are used to place new upper limits to the hard x-ray flux from the quiet sun. The data, obtained in 1965 with a balloon-borne scintillation detector, allow the upper limits to the hard x-ray flux suggested by OSO 1 measurements to be lowered by nearly two orders of magnitude. Upper limits to the Jovian x-ray flux are also discussed. (auth)

22957 A HIGH-RESOLUTION STUDY OF THE DISTRIBUTION AND MOTIONS OF NEUTRAL HYDROGEN IN THE SMALL CLOUD OF MAGELLAN. Hindman, J. V. (CSIRO, Chippendale, Australia). Austral. J. Phys., 20: 147-71(Apr. 1967).

Observations of radiation from neutral hydrogen in the Small Cloud of Magellan at a wavelength of 21 cm have been made using the 210-ft Parkes telescope and a multichannel receiver. Profiles were observed over an area of 30 sq deg of sky. There is good correlation between the distribution of the neutral gas and the bright stars, but no detailed correspondence with clusters or Cepheids has been found. Well-defined structure is evident in the velocity distribution of the gas, which is interpreted as originating in a number of expanding gas shells between 1 and 2 kpc in diameter and containing from 1 to 2×10^7 $M_\odot$ of neutral hydrogen. A rotation curve has been derived and the total mass of the SMC estimated at 1.5×10^9 $M_\odot$, while the corresponding mass of neutral hydrogen in the system is 5×10^8 $M_\odot$. (auth)

22958 ROTATING POLYTROPES IN THE POST-NEWTONIAN APPROXIMATION. Sudbury, A. W. (Monash Univ., Clayton, Australia). Austral. J. Phys., 20: 193-6(Apr. 1967).

It has been suggested that rotation would make a star more stable but, so far, the problem has not been treated without assuming that the star retains its shape, and the post-Newtonian rotation terms have not been included. The structures of rotating polytropes in general relativity were determined and the metric coefficients for a rotating polytrope of index n = 3 are given. (W.D.M.)

22959 THE TWO COMPONENTS OF THE RADIO SOURCE W 49. Sato, F. (Tokyo Univ.); Akabane, K.; Kerr, F. J. Austral. J. Phys., 20: 197-201(Apr. 1967).

The radio source W 49 (3C 398) has a thermal and a nonthermal component. From observations of 21-cm hydrogen line absorption, Akabane and Kerr (1965) derived a distance of about 15 kpc for the thermal component. An attempt was made to obtain information about the distance of the nonthermal component by the same method. From the observations and the discussion, it is concluded the W 49 is not a physically related double source. The nonthermal component appears to be closer by about 1 kpc. (W.D.M.)

22960 A SEARCH FOR OH EMISSION FROM THE MAGELLANIC CLOUDS. Radhakrishnan, V. (CSIRO, Chippendale, Australia). Austral. J. Phys., 20: 203-4(Apr. 1967).

The rich variety and large number of H II regions in the Magellanic Clouds prompted a preliminary search for high-intensity anomalous OH emission similar to that observed in the direction of galactic H II regions. On the basis of the negative results obtained, clearly no significant conclusions can be drawn as to the abundance of OH in the Magellanic Clouds or as to the prevalence of conditions favoring anomalous emission. (W.D.M.)

22961 EVIDENCE FOR AN ASSOCIATION BETWEEN MAGNETIC FIELD AND GAS OUTFLOW FROM A SPIRAL ARM. Gardner, F. F.; Whiteoak, J. B.; Morris, D. (CSIRO, Sydney). Nature, 214: 371-2(Apr. 22, 1967).

Between Nov. 1963 and Oct. 1966, employing the Parkes 210 ft telescope, determinations were made of the polarisation of about 500 extra-galactic radio sources, and evidence was obtained for irregularities in the magnetic field in two directions of our galaxy. The overall galactic distribution of polarised sources is shown graphically. Attention is directed to two directions in which Faraday rotation values are large, but reverse sense, for directional changes of a few degrees. These values are unusually large for directions generally considered perpendicular to the magnetic field of the local spiral arm. The direction located at galactic longitude 180° and latitude −30° contains a spur of neutral hydrogen in which there is a narrow tongue of gas flowing away from the solar neighbourhood with a velocity of +6 to +9 km/sec. It is suggested that the two phenomena are related, and that the polarisation data are consistent with lines of magnetic field dragged out of the spiral arm by the gas flow. The other field irregularity near galactic longitude 15° and latitude +10° is not so well defined by the data, but coincides with another neutral hydrogen spur, where again the gas flow is outward. (UK)

22962 CALCULATIONS OF THE EINSTEIN A COEFFICIENT FOR THE 18 cm TRANSITION OF OH. Turner, B. E. (Univ. of California, Berkeley). Nature, 214: 379(Apr. 22, 1967).

Some alleged errors and inconsistencies in the calculations are discussed (see also Nature 213: 694(1967) and 212: 184(1966)). (UK)

22963 21-CM OBSERVATIONS OF NGC 300. Shobbrook, R. R. (Univ. of Sydney); Robinson, B. J. Austral. J. Phys., 20: 131-45(Apr. 1967).

The 210-ft radio telescope at Parkes was used to determine the profiles of the 21-cm line from neutral hydrogen at about 100 points over the Sc galaxy NGC 300. The systemic velocity is +145 km/sec, and the mass of neutral hydrogen is 2.1×10^9 $M_\odot$. The total mass, determined from a rotation curve constructed from the velocities of the peaks of the profiles, is 2.5×10^{10} $M_\odot$, for an assumed distance of 1.9 Mpc. There is a large cloud of neutral hydrogen, extending over at least 4.5° by 3°, situated to the southeast of NGC 300. This cloud has a velocity with respect to the sun of +40 km/sec. In view of the fact that the velocity contours and the neutral hydrogen contours in the galaxy are quite strongly distorted in the direction of this cloud, it is suspected that the cloud lies near NGC 300. It then has a neutral hydrogen mass of the order of 10^8 to 10^9 $M_\odot$. (auth)

22964 DISTRIBUTION AND VARIABILITY OF COSMIC X-RAY SOURCES. Friedman, H.; Byram, E. T.; Chubb, T. A. (Naval Research Lab., Washington, D. C.). Science, 156: 374-8(Apr. 21, 1967).

At least 30 discrete cosmic x-ray sources have been detected thus far. The distribution is concentrated toward the galactic plane, and most of the sources are believed to lie within 2 kiloparsecs of the sun. It is estimated that the average luminosity of the observed sources is about 5×10^{36} ergs per second and that the entire galaxy contains about 1250 such sources. Comparisons of fluxes observed over the course of the past 2 years reveal that many sources are highly variable. (auth)

22965 HIGH RESOLUTION OBSERVATIONS OF NEUTRAL HYDROGEN IN THE SMALL CLOUD OF MAGELLAN. Hindman, J. V.; Balnaves, Kathleen M. (CSIRO, Chippendale, Australia). Austral. J. Phys., Astrophys. Suppl. No. 4, 3-38 (Apr. 1967).

Observations of 21-cm line radiation from neutral hydrogen in the Small Magellanic Cloud are presented in the form of contour diagrams. The survey covers the area of sky from R. A. 00^h00^m to 01^h30^m between Dec. −70° and −76°, with some observations to beyond R. A. 01^h40^m. Profiles were observed on a 6′ arc grid. The aerial resolution was 14′.6 arc and the velocity resolution of the receiver 7.0 km/sec. (auth)

22966 ELEVEN-YEAR SOLAR ACTIVITY CYCLE. Gnevyshev, M. N. Usp. Fiz. Nauk, 90: 291-301(Oct. 1966). (In Russian).

Results of a former investigation are summarized and more recent supplementary data provided. The two maxima in the solar activity were observed in the intensity of the coronal green line in each solar cycle and also in the area of sunspots. The growth of sunspots during the two maxima as a function of solar latitude is shown. Sunspots were classified according to their areas, and the frequency of appearance of area classes during the whole activity cycle was studied. The distribution of various classes during the cycle is also shown. Small spots have only one maximum. Spots larger than 200 area units have two maxima. This analysis shows the definite presence of two maxima in the appearance of large spots. The appearance of flares during the 19th solar activity cycle was investigated by separating chromospheric flares from proton flares (solar cosmic rays); this distribution during the cycle is given. The presence of two maxima and a weak third maximum at the end of the cycle is indicated; the second maximum depends upon the activity of the phenomenon. Correlations between the solar activity and geophysical phenomenon, especially in geo-

magnetic perturbations, have been known for a long time. The curves of Bartels' index of global geomagnetic activity and the intensity of the coronal line at 5303 Å, which characterizes the coronal activity, are given. The correlation coefficient of those lines was found to be 0.98 ± 0.01. Both curves exhibit two maxima. Comparison of the variation of the intensity of the green coronal line with other geophysical phenomena during the 19th solar activity cycle made it possible to establish new correlations. Analysis of maps of barometric levels showed that regions of maximum and minimum pressures formed ring-shaped zones similar to the auroral zone. The formation of these zones is associated with solar winds. Curves of pressure zones and the intensity of the green line are correlated. It was established that chemical and biological processes also exhibit two maxima during a solar cycle. (ATD)

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Refer also to abstracts 22771, 23305, and 23559.

22967 (AD-643013) INTERACTIONS BETWEEN HYDROGEN AND OXYGEN ATOMS AND SURFACES. Annual Technical Summary Report, October 1, 1965–September 30, 1966. Smith, Joe N. (General Dynamics Corp., San Diego, Calif. General Atomic Div.). Oct. 27, 1966. Contract AF 49(638)-1435. 26p. (GA-7467; AFOSR-66-2740). CFSTI $3.00 cy, $0.65 mn.

The ultimate goal of the research program is to provide data concerning the transfer of energy and momentum between atoms and molecules and a solid surface in free-molecule flow, and to investigate other processes that may occur in the gas-surface interaction. The work during the reporting period was largely confined to two areas: light gas (He, H_2, and D_2) scattering from (111) Ag, and construction and testing of a compact slotted-disc velocity selector. In addition, some measurements were made of Ar scattering out of the plane of incidence. (TAB)

22968 (AD-643532) TEMPERATURE MEASUREMENTS ON ELECTRON AND ION BEAMS. Heil, H.; Scott, B. (Hughes Research Labs., Malibu, Calif.). Aug. 1966. Contract AF 19(628)-4297. 41p. (AFCRL-66-769). CFSTI $3.00 cy, $0.65 mn.

The retarding potential method produced temperature measurement accuracies which are comparable to or better than those possible with the best pyrometers or thermocouples. The method is limited to a close-spaced planar diode with a collimating magnetic field to avoid nonaxial forces. In addition, the complete hemisphere of angles in the distribution must contribute in order to yield the simple current–voltage relation $i(v) = e^v$; $(v < 0)$. In contrast, the total energy distribution function for a Maxwellian reads $i(v) = (1 - v)e$ to the v power. It may be measured with an energy spectrometer which is sensitive to the total energy only. Such an instrument is described. In this case the source and spectrometer may be far apart. On its way to the spectrometer the beam may be accelerated, focused, or generally subjected to nonaxial forces. Furthermore, completeness of the angular distribution is not required. A graphical method for accurate temperature determination from a recorded energy spectrum is described. As examples, the electron spectrum from a vidicon gun with oxide coated cathode and the ion spectrum from the plasma of a plane parallel cesium diode are shown. (auth)

22969 (LA-DC-7484) ROTATIONAL EXCITATION OF O_2 BY SLOW ELECTRONS. Sampson, Douglas H. (General Electric Co., Philadelphia, Pa. Missile and Space Div.); Mjolsness, Raymond C. (General Electric Co., Philadelphia, Pa. Missile and Space Div. Los Alamos Scientific Lab., N. Mex.). [1965]. Contract W-7405-eng-36. 17p. Dep. mn. CFSTI $3.00 cy, $0.65 mn.

Results of a distorted wave calculation of the cross section for rotational excitation of O_2 by slow electrons are given for electron energies ≤1 eV and a large range of values for the electric quadrupole moment. Use of the observed quadrupole moment leads to disagreement with observed energy loss rates. (auth)

22970 (N-67-14398) ADIABATIC EXCITATION TRANSFER IN GASES: EFFECTS ON TRANSPORT. Nyeland, Carl; Mason, E. A. (Maryland Univ., College Park. Inst. for Molecular Physics). Dec. 22, 1966. 22p. (NASA-CR-80872; IMP-NASA-58). CFSTI $3.00 cy, $0.65 mn.

A calculation is made of the contribution to the transport coefficients from adiabatic excitation transfer in atomic gases. Atomic nitrogen is chosen as an example, and the necessary potential curves are determined partly from spectroscopic data and partly from Heitler–London calculations. Exchange greatly reduces the rate of diffusion of internal electronic energy, and the contribution of the ^2D and ^2P excited states of N to the thermal conductivity at 10,000°K is reduced by a factor of three (from 48% to 16% of the translational thermal conductivity). Reasons are given to suppose that such behavior is fairly general, and not restricted to nitrogen. (auth)

22971 (N-67-15668) QUANTUM MECHANICAL STUDY OF MOLECULES: PREDICTION OF THE GROUND, IONIZED, AND EXCITED STATES OF THE UNKNOWN NF MOLECULE. Sanni, Roop C. (New York Univ., N. Y.). Jan. 1967. 23p. (NASA-CR-688). CFSTI $3.00 cy, $0.65 mn.

The ground, ionized, and excited states of the unknown NF molecule were computed at a number of internuclear distances to determine their stability, equilibrium distances, ionization, and excitation energies. In these calculations all the atomic and molecular integrals were computed correctly to six decimal places. The configurations of the different states of NF were derived from the configurations of the corresponding states of the isoelectronic O_2 molecule. The percentage accuracy of the computations of the states of NF was estimated by carrying out similar types of calculations on the different states of the known N_2, CO, and O_2 molecules. (auth)

22972 (ORO-3557-1) PROTON SPUTTERING. Annual Progress Report No. 1, June 1, 1966–February 28, 1967. Finfgeld, Charles R. (Roanoke Coll., Salem, Va. Dept. of Physics). Feb. 28, 1967. Contract AT(40-1)-3557. 15p. Dep. mn. CFSTI $3.00 cy, $0.65 mn.

The design of a system to be used for measurement of the yield and angular distribution of Au sputtered by protons of energies between 1.0 and 11.0 keV is discussed briefly, and progress in preparation of the components of the system is reported. The system is about to be assembled. (A.G.W.)

22973 (RT/FI-(66)35) ELECTRON ENERGY DISTRIBUTIONS IN RARE GASES IN A dc ELECTRIC FIELD AT LOW E/N VALUES. Braglia, G. L. (Parma Univ. (Italy). Istituto di Fisica); de'Munari, G. M.; Mambriani, G. (Parma Univ. (Italy). Istituto di Fisica. Istituto Nazionale di Fisica Nucleare, Milan (Italy)). Sept. 1966. 66p. Dep. mn.

The steady-state distributions of electron energies in helium, neon, argon, krypton, and xenon are given at values of E/N (ratio of dc electric field to gas atom number density) up to $E/N \simeq 10^{-17}$ V cm^2. (auth)

22974 (TID-23789) RADIATION INDUCED LUMINESCENT PROCESSES IN GASES. Progress Report. Llewellyn, J. A.; Keirs, Russell J. (Florida State Univ., Tallahassee). Nov. 23, 1966. Contract AT(40-1)-3349. 36p. Dep. mn. CFSTI $3.00 cy, $0.65 mn.

The research in the visible region of the spectrum has resulted in completion of an excitation atlas for argon and neon under 3-MeV electron bombardment at pressures of 500 to 1000 mm. The effects observed on adding nitrogen to these systems suggested a series of experiments on nitrogen leading to measurement of electron-impact excitation cross sections for two of the bands observed in the high-energy systems. Scintillation decay times for luminescence in nitrogen were determined and interpreted in terms of natural lifetimes for the excited states concerned. The energy transfer processes made apparent by the spreading of electron-beam-induced luminescence have been studied and some tentative conclusions are presented. This phenomenon suggests a possible source of information concerning the secondary processes involved in the deposition of energy by radiation in gases. Preparations for experiments intended to investigate ultraviolet emission down to the lithium fluoride limit, using a McPherson photoelectric spectrometer in conjunction with the tandem accelerator, are almost completed. (auth)

22975 (USC-136-119) ELASTIC SCATTERING SEARCH PROGRAM. Smith, William R. (University of Southern California, Los Angeles. Dept. of Physics). Feb. 1967. Contract AT(04-3)-136. 63p. Dep. mn. CFSTI $3.00 cy, $0.65 mn.

A FORTRAN computer program is described which employs the optical model to calculate the elastic scattering resulting from the collision of any two nuclear particles. The spin–orbit coupling potential acting between the two particles can also be included provided that the incident particle has spin zero, one-half, or one. The optical model potential is composed of a three-parameter Woods–Saxon real part and an independent four-parameter imaginary part having a variable ratio of surface and volume components. The program also includes a search routine which automatically seeks the parameters which yield the best least-squares agreement between the calculated predictions and the experimental data. (auth)

22976 (USNRDL-TR-1102) CHARGED PARTICLE TRACKS IN POLYMERS. NO. 3: RANGE AND ENERGY LOSS TABLES. Henke, R. P.; Benton, E. V. (Naval Radiological Defense Lab., San Francisco, Calif.). Nov. 21, 1966. 39p.

The range and energy loss rate for the ions ^1H, ^4He, ^{12}C, ^{16}O,

^{20}Ne, ^{28}Si, ^{40}Ar, ^{56}Fe, and ^{84}Kr are given in the energy/nucleon interval 0.1 to 1200 MeV/amu. These quantities are tabulated for the stopping materials cellulose nitrate, cellulose acetate butyrate, HBpaIT polyester, Lexan, Mylar, muscovite and phlogopite mica, soda lime and phosphate glass, and olivine. The values for a given stopping material can be extended to other materials with similar values of the mean excitation potential by simple scaling. The computation involved a published mathematical method, which was modified and extended to lower energies. (auth)

22977 ELECTRON IMPACT BROADENING OF POSITIVE ION LINES. Brechot, S. (Observatoire de Paris). Phys. Rev. Lett., 24A: 476-7(Apr. 24, 1967).

Recent measurements of the Stark broadening of positive ion lines disagree with Griem's calculations. In this paper the Coulomb attraction is included and then the agreement for the H and K Ca II lines is good. (auth)

22978 PROPERTY OF TRANSITION RADIATION IN THE OPTICAL REGION. Amatuni, A. Ts.; Garibyan, G. M. Izv. Akad. Nauk Arm. SSR, Ser. Fiz., 1: 342-6(1966). (In Russian).

Transition radiation generated by charged particles in the region of optical spectrum frequency where the dielectric constant is near unity was investigated. (auth)

22979 HARTREE–FOCK THEORY: SLATER DETERMINANTS OF MINIMUM ENERGY. Kaplan, T. A.; Kleiner, W. H. (Massachusetts Inst. of Tech., Lexington). Phys. Rev., 156: 1-11(Apr. 5, 1967).

A theorem is proved (on the basis of physically reasonable assumptions) to the effect that in Hartree–Fock (HF) theory an electron can always be added to an N-electron system without raising its energy. The theorem is applied to show that the conventional HF wave function is unstable for certain negative atomic ions (H^-, Li^-, B^-, N^-, N^{2-}, O^-, O^{2-}, Na^-, P^-), and that the typical extent of the instability is chemically significant. A consequence of the instability is that the lowest level in HF theory does not have the symmetry of the exact ground level. This is the case, in particular, for the closed-shell ions H^-, Li^-, O^{2-}, and Na^-—a result contrary to some earlier expectations. The two-electron one-center system with fixed nuclear charge Ze (Z not restricted to integer values) is investigated in detail on the basis of a simplified model defined by specifying restrictions that the allowable determinantal wave functions must satisfy. The orbitals of the determinantal wave functions of the model are of the form $\psi_i = v_i\chi_i$, $i = 1, 2$, where χ_i is a spin function and v_i is essentially of 1s hydrogenic form. As Z decreases, the model shows explicitly the onset of the instability described above. It further shows that for $Z > 1$, any true minimum-energy determinant D_g is bound (although the interesting question of whether D_g is bound for $Z \leq 1$, apparently raised here for the first time, remains unanswered). A precise analogy between the electron problem and certain spin problems is defined. This analogy sheds light on the HF approximation. It leads to examples that show strikingly that it is important not to always impose symmetry restrictions on an otherwise restricted wave function; the analogy also makes clear, in a simple way, certain points fundamental to an understanding of HF theory. Some possible implications of the results of this paper for solid-state calculations are discussed. (auth)

22980 THEORY OF ATOMIC COLLISIONS WITH NEGATIVE IONS: ASSOCIATIVE DETACHMENT. Chen, Joseph C. Y. (Univ. of California, San Diego, La Jolla). Phys. Rev., 156: 12-25(Apr. 5, 1967).

The problem of atomic collisions with negative ions is considered and special attention is given to the rearrangement process of associative electron detachment. After the various possible processes, the interaction potentials, and the related problems of potential curves are described physically, a theoretical formulation of the problem is presented, ranging from general formalism to explicit formulas for the reaction cross section and the rate coefficient. In the general formalism, transition matrices are derived for direct and resonance reactions as well as for potential and resonance scatterings. The process of associative detachment is then treated explicitly, using these derived expressions. It is shown that because of the configuration interaction of the electronic motion with continua, the nuclear motion is taking place in a complex potential. The propagation of a nuclear state in such a complex potential is treated in some detail. Various implications of the derived theoretical results are discussed in connection with experimental observations. (auth)

22981 THEORY OF X-RAY SATELLITES. Aberg, Teijo (Inst. of Tech., Otaniemi, Finland). Phys. Rev., 156: 35-41 (Apr. 5, 1967).

A general theory has been developed with regard to x-ray excitations, based on the method of the sudden approximation. As one application, the production probabilities of all the normal single-hole x-ray states of F^-, Ne, Na^+, Cl^-, Ar, and K^+ have been calculated in a self-consistent-field approximation. These production probabilities have been employed for derivation of the KL-satellite intensity values 36.5% (F^-), 21.1% (Ne), and 14.3% (Na^+) relative to the $K\alpha_{1,2}$ line and the KM-satellite intensity values 39.7% (Cl^-), 26.2% (Ar), and 19.3% (K^+) relative to the $K\beta_{1,3}$ line. In calculation of the relative satellite intensities, account has been taken of the difference between the oscillator strengths of the main line and the satellites, and the decay of KL to the KM states of Cl^-, Ar, and K^+. It has further been shown that the exchange probabilities can be ignored in these calculations. The satellite intensities calculated display close agreement with the experimental intensities obtained from Deslattes's measurements as concerns Cl^- and Ar, although there is a slight disagreement in the case of K^+. It has been suggested that the usual criterion of validity for sudden approximation need not be fulfilled exactly in applications, and in connection between the sudden-approximation probability and the dipole-transition probability has been found. In conclusion, there is a discussion of solid-state effects on the satellite intensities. (auth)

22982 FORMATION OF STABLE MOLECULES WITHIN THE STATISTICAL THEORY OF ATOMS. Balazs, Nandor L. (State Univ. of New York, Stony Brook). Phys. Rev., 156: 42-7(Apr. 5, 1967).

It is shown that no theory can describe a stable molecule or molecular ion if it expresses the charge density as a function of the electric potential alone. Such theories comprise the Thomas–Fermi, Thomas–Fermi–Dirac, Thomas–Fermi–Gombás theories. The Thomas–Fermi theory with the Fermi–Amaldi correction cannot give rise to molecular binding for homonuclear, diatomic, neutral molecules if the total number of electrons in the molecule equals or exceeds 4. The Thomas–Fermi–Weizsäcker theory gives stable homonuclear, diatomic molecules. (auth)

22983 CROSSED-BEAM MEASUREMENT OF THE ELECTRON-IMPACT POLARIZATION OF HELIUM 4922 A OPTICAL RADIATION. McFarland, Robert H. (Univ. of California, Livermore). Contract W-7405-eng-48. Phys. Rev., 156: 55-8 (Apr. 5, 1967). (UCRL-70060).

Nonzero threshold polarization of helium 4922 Å optical radiation, as first reported by the author, has since been observed by Heddle and Keesing. A recent experiment designed to minimize elastic gas scattering of the electrons has involved He pressures ranging from 10^{-7} to 10^{-4} torr, background pressures of 3×10^{-8} torr, an optical resolution of less than 10 Å half-intensity width, zero-magnetic-field focusing of electrons, and gas scattering of the electron beam of less than 1%. The energy resolution of the electron beam was of the order of 0.2-eV half-intensity width. Customary photon-counting rates varied from background to 100 counts/sec with a background of about 1 count/sec. Thus, obtaining satisfactory counting statistics presented no appreciable problem, except at threshold. The results compare with those reported earlier, suggesting that the energy dependence of the polarization, which dips to a near-threshold minimum of approximately 30%, is a real effect. The observation has not been adequately explained. (auth)

22984 ANALYSIS OF π^--MESONIC ATOMS. Seki, Ryoichi; Cromer, Alan H. (Northeastern Univ., Boston). Phys. Rev., 156: 93-8(Apr. 5, 1967).

A phenomenological analysis of the π^--mesonic atom in light nuclei has been made by use of a new approximation technique for the exterior wave function outside the region of strong interaction. This approximation is a series expansion of the Coulomb wave function in terms of the energy-level-shift ratio $\Delta E_{1S}/E_{1S}$. From the new measurements of Jenkins, Kunselman, Simmons, and Yamazaki of the shifts and spreads of the $2P \rightarrow 1S$ transition energy in π^--mesonic atoms, the complex π^--nucleus potential and the exact π^--nucleus scattering length were calculated. The π^--nucleus scattering lengths are found not to satisfy the hypothesis that they are the sums of π^--nucleon scattering lengths. Also the scattering lengths do not exhibit any apparent isotopic-spin dependence. It is also found that level shift depends only on the volume integral of the potential and not on its shape. This potential is used to obtain the π^--mesonic wave function inside the nucleus in analytic form, and it is found that the probability that the π^- meson is inside the nucleus has only about half the value given by a first-order perturbation calculation. (auth)

22985 BETHE–GOLDSTONE EQUATIONS IN SCATTERING THEORY. Nesbet, R. K. (IBM Research Lab., San Jose, Calif.). Phys. Rev., 156: 99-102(Apr. 5, 1967).

The use of a continuum Bethe–Goldstone equation, recently proposed by Mittleman, to describe electron scattering by an alkali atom, is generalized by introducing the concept of continuum Bethe–Goldstone equations of successively higher order. In anal-

ogy to a method recently used for calculating mean-value properties of atomic stationary states, this makes possible the computation of net increments of a scattering amplitude or phase shift in successively higher orders, defined so that the sum of all net increments to order N (for an N-particle system) is the exact amplitude or phase shift. Variational equations that might be used to solve a continuum Bethe–Goldstone equation of order n are derived. Solution of a system of inhomogeneous linear equations is combined with integration of an integro-differential equation similar to a continuum Hartree–Fock equation. The formalism should be applicable to elastic scattering of an external particle by any many-fermion system. (auth)

22986 KINETIC-ENERGY DISTRIBUTION OF NEGATIVE IONS FORMED BY DISSOCIATIVE ATTACHMENT AND THE MEASUREMENT OF THE ELECTRON AFFINITY OF OXYGEN. Chantry, P. J.; Schulz, G. J. (Westinghouse Research Labs., Pittsburgh). Phys. Rev., 156: 134-41(Apr. 5, 1967).

The kinetic-energy distribution of ions produced by a dissociative ionization process is derived, taking into account the effect of thermal motion of the target molecule. In the case of dissociative attachment of monoenergetic electrons to a diatomic molecule, the width at half-maximum of the negative-ion energy distribution is given by $(11\beta kTE_0)^{1/2}$, where β is the ratio of the mass of the ion to that of the parent molecule, T is the target-gas temperature, and E_0 is the most probable ion energy. A crossed-field velocity filter was used to study O^- ion energy distributions arising from the attachment of essentially monoenergetic electrons to O_2 as a function of electron energy at two gas temperatures. The measured widths of the distributions are consistent with the above relationship. Measurements of E_0 as a function of the electron energy allow a determination of the electron affinity A of atomic oxygen. The result, A = 1.5 ± 0.1 eV, is in excellent agreement with photodetachment-threshold determinations. (auth)

22987 DOUBLE ELECTRON EJECTION RESULTING FROM PHOTOIONIZATION IN THE OUTERMOST SHELL OF He, Ne, AND Ar, AND ITS RELATIONSHIP TO ELECTRON CORRELATION. Carlson, Thomas A. (Oak Ridge National Lab., Tenn.). Contract W-7405-eng-26. Phys. Rev., 156: 142-9(Apr. 5, 1967). (ORNL-P-2692).

The probability of ejecting two or more electrons by the interaction of an x ray with the outermost shell of He, Ne, and Ar has been investigated. The relative abundances of doubly charged to singly charged ions following x irradiation have been measured with a charge spectrometer. These ratios are essentially constant over the range of x-ray energies from 3 to 8 times the threshold for double ionization. They are, respectively, 0.035, 0.14, and 0.17 for He, Ne, and Ar. Energy spectra for electrons ejected in photoionization have been measured with an electron spectrometer. In addition to characteristic photolines, continuum spectra are found, which are related to double electron ejection. The probabilities for double electron ejection as determined from these spectra are in agreement with those obtained by charge spectrometry. The shapes of the continuum spectra are qualitatively similar to those expected for electron shake-off. However, the probabilities for electron shake-off as calculated from single-electron wave functions are much smaller than found experimentally. It is suggested that a many-body solution that explicitly includes electron correlations may be necessary. For example, such a calculation by Salpeter and Zaidi, for the case where one electron goes to the continuum while the other goes to the 2s state in the photoionization of He, is shown to be in good agreement with experiment. Some results are also presented on the differential cross sections of Ne and Ar for C Kα x rays. (auth)

22988 STRUCTURE OF RESONANCES IN ELECTRON SCATTERING BY HYDROGEN ATOMS. Chen, Joseph C. Y. (Univ. of California, San Diego, La Jolla. Joint Inst. for Laboratory Astrophysics, Boulder, Colo.). Phys. Rev., 156: 150-64(Apr. 5, 1967).

A study of the structure of resonances just below the n = 2 excitation threshold in electron scattering by hydrogen atoms is carried out by utilizing an approximate method adopted from the projection-operator formalism. Analytic expressions for the level width near the threshold are obtained for both the singlet- and triplet-compound-state series with zero total angular momentum. It is found that the level widths behave like the level spacings in that they decrease exponentially as the levels approach the threshold. Nevertheless, the ratio between the level spacings and widths remains a constant less than 1. It is then concluded from the study that within the approximations adopted in the method, neither the singlet nor triplet series of the compound states becomes overlapping near the threshold. However, the Lamb shift may, by removing the degeneracy in the n = 2 levels, cut off these infinite sequences of compound states, thereby restricting the number of allowed resonances. The interference between potential and resonance scatterings is also examined. (auth)

22989 LOWEST ^1S AND ^3P SCATTERING RESONANCES IN THE e–H SYSTEM. McGowan, J. William (Joint Inst. for Laboratory Astrophysics, Boulder, Colo.). Phys. Rev., 156: 165-72 (Apr. 5, 1967).

A study of the position and width of the lowest ^1S and ^3P resonances in the e–H system was made by judiciously comparing the published data of McGowan, Clarke, and Curley with values of the cross section calculated for a variety of resonance positions E_0^+ and E_1^-, and widths Γ_0^+ and Γ_1^-. It is determined that the ^1S and ^3P resonance positions are $E_0^+ = 9.56 \pm 0.01$ eV and $E_1^- = 9.71 \pm 0.03$ eV, while the respective widths are $\Gamma_0^+ = 0.043 \pm 0.006$ eV and $\Gamma_1^- \geq 0.009$ eV. The resonance shapes are shown to depend critically upon both the angle of observation and the angular resolution. (auth)

22990 CHARGED BOSON GAS AT HIGH DENSITY. Brueckner, Keith A. (Univ. of California, San Diego, La Jolla). Phys. Rev., 156: 204-6(Apr. 5, 1967).

The ground-state energy of a charged boson gas at high density is evaluated exactly to second order in the density expansion, making use of complete sums of one- and two-ring diagrams. The result agrees numerically with Feenberg's variational calculation of the energy, although the methods appear to be substantially different. The presence of logarithmic terms in the energy, which are absent in the exact result, is shown to be a result of truncation of the Hamiltonian in the pair approximation or of inadequacies of variational wave functions that omit interpair correlations. (auth)

22991 CONDUCTIVITY OF NITROGEN IONIZED BY COLLISION. Valentin, Pierre; Cottereau, Marie-Joseph (Faculte des Sciences, Rouen). Compt. Rend., Ser. B, 264: 603-6(Feb. 20, 1967). (In French).

The results of conductivity measurements of nitrogen ionized by collision, using a four-electrode device, are given. The experimental values are compared with the theoretical values. (tr-auth)

22992 EXCITATION OF THE ELECTRON SHELL OF Rb^+ AS A SECONDARY EFFECT IN THE β DECAY OF ^{85}Kr. Andrae, H. J.; Luchner, K.; Schambeck, W. (Technische Hochschule, Munich). Z. Naturforsch., 21a: 1987-8(Nov. 1966). (In German).

The first results obtained in the detection of the light emission following the shell rearrangement after the β decay of ^{85}Kr are reported. Photons from an apparatus filled with ^{85}Kr-enriched Kr were measured in coincidence with the β particles of the ^{85}Kr decay. The β-photon coincidence was measured in the wavelength interval from 4110 to 4180 Å. The photon emission probability per β decay and per wavelength unit was determined as a function of the wavelength. A probability for photon emission of the wavelength 4136 Å of 0.46 ± 0.05% was obtained per β decay. The data indicated that lines of this intensity can occur when a 4p electron is excited from the $4s^24p^6$ into the $4s^24p^55p$ configuration. (J.S.R.)

22993 MOTION AND RADIATION OF AN ELECTRON IN HOMOGENEOUS MAGNETIC AND WEAK ELECTROSTATIC FIELDS. Zhukovskii, V. Ch.; Korovin, Yu. A. (Moscow State Univ.). Izv. Vyssh. Ucheb. Zaved., Fiz., No. 6, 11-17(1966). (In Russian).

Spontaneous radiation intensity characteristics of spectral and angular distribution in relativistic and non-relativistic cases were found for an electron moving in crossed static, electrical, and homogeneous fields. A systematic mathematical analysis was made of the motion and emission of electrons in constant homogeneous magnetic and weak electrostatic fields. (R.V.J.)

22994 QUANTAL TREATMENT OF DIRECTIONAL EFFECTS FOR ENERGETIC CHARGED PARTICLES IN CRYSTAL LATTICES. Lervig, Philip; Lindhard, Jens; Nielsen, Vibeke (Univ. of Aarhus, Denmark). Nucl. Phys., A96: 481-504(1967).

Directional effects for energetic charged particles in crystals involve scattering by small angles, and were previously found to be largely classical. In the present quantal treatment, the preponderant forward scattering in collisions with atoms allows a time-dependent Schrödinger formulation and a sudden collision approximation. The resulting general scattering formula is shown to contain, e.g., both classical mechanics and Born approximation, and includes incoherence phenomena. Solutions are obtained for wave propagation in periodic systems, e.g., strings of atoms. A formula is derived for probability of penetration of atomic centres. With exceptions for positons and negatons, particles do not, at any energy, penetrate perceptibly into classically forbidden regions. Interference and incoherence is also treated, but interference becomes weak for positive particles. (auth)

22995 RADIATION OUTPUT AND QUALITY OF X-RAY TUBES WITH BERYLLIUM WINDOWS AS A FUNCTION OF ANODE MATERIAL. Schaal, A.; Kausche, H. (Siemens-Schuckertwerke AG, Erlangen, Ger.). Z. Angew. Phys., 22: 220-2(1967). (In German).

Calibration of ion dose output of x-ray tubes with beryllium windows resulted in essentially lower values with tubes containing Mo-respective Ag-anode materials as compared with tubes containing anode material of lower atomic weight. This is caused by the different attenuation of the radiation within the anode and through characteristic radiation. Specifying the dose output is not sufficient for irradiation purposes. The radiation attenuation for instance for aluminum must be allowed for additionally. This results that with objects that do not attenuate the radiation at 60 kV tube potential by more than 2 mm aluminium equivalent, a molybdenum or silver tube should be used in preference to a tungsten tube. If the radiation that is emitted from the tube is filtered in such manner that the characteristic radiation of the anode material can be neglected, then the dose output is proportional to the ordinal number of the material concerned. At low filtering values this is never the case. (auth)

22996 INFLUENCE OF CHARGE DISTRIBUTION ON NONEQUILIBRIUM IONIZATION OF SOLID PARTICLES. Biasi, L. (Univ., Milan); Tozzi, A. Brit. J. Appl. Phys., 18: 219-23(Feb. 1967).

The nonequilibrium ionization of a gas–solid suspension expanding supersonically in a nozzle was studied, taking into account the charge distribution among the particles. The distortions of the distribution, due to nonequilibrium effects, were also examined. It is shown that the determination of the nonequilibrium ionization of such a system may be considerably simplified by introducing an averaged value for the charge distribution, only in the case of high degrees of ionization. (auth)

22997 SEMICLASSICAL THEORY OF PROTON TRANSPORT IN ICE. Kim, Dong-Yun; Schmidt, V. Hugo (Montana State Univ., Bozeman). Can. J. Phys., 45: 1507-16(Apr. 1967).

A method is described for calculating proton or other ion mobility which is applicable if mobility is limited by lattice scattering rather than by barrier jumping. The Boltzmann transport equation is used, with the collision term calculated from the electrostatic interactions between the mobile ion and the vibrating lattice. In particular the proton mobility in ice is calculated. The lattice vibrations are approximated by a Debye spectrum for translational vibrations of water molecules, plus an Einstein spectrum for modes in which protons vibrate almost as independent particles. Scattering by phonons somewhat below the Debye cutoff frequency is of the greatest importance in determining the mobility, and the proton modes have negligible effect. The calculated mobility agrees reasonably well with the experimental value. (auth)

22998 ELECTRON TRANSFER TO MULTIPLY CHARGED IONS OF Ar, N_2, N, AND O_2. McGowan, J. William (General Atomic Div., General Dynamics Corp., San Diego, Calif.); Kerwin, Larkin. Can. J. Phys., 45: 1451-67(Apr. 1967).

Cross sections for the transfer of one and of two electrons to fast doubly charged ions of Ar, O, N_2, N, and to the triply charged ion of Ar are presented. The 20/02 reaction of Ar^{2+} in Ar is resonant and smaller than that for Ar^+ in Ar. The nonresonant, single-charge transfer process 20/11, even though it is exothermic, required that 12.5 ± 2.0 eV be transferred to the reaction from the kinetic energy of the projectile for the reaction to go. Consequently, the scatter of the fast Ar^+ products is very large. Similarly, large scatter is observed for the double-electron transfer to Ar^{3+} as the ion traverses an argon target. Unlike the above, however, single- and double-electron transfer to O^{2+} from O_2 and to N_2^{3+} from N_2, double transfer from Ar to Ar^{2+}, and single and triple transfer from Ar to Ar^{3+} show but small scatter. (auth)

22999 EXCITATION CROSS SECTION OF SOME OF THE STATES OF Ne II, Ar II, AND Kr II BY ELECTRON COLLISION. Koozekanani, S. H. (Ohio State Univ., Columbus). IEEE (Inst. Elec. Electron. Eng.), J. Quantum Electron., QE-2: 770-3(Dec. 1966).

The sudden perturbation method was used to calculate the excitation cross section of some of the states of Ne II, Ar II, and Kr II by high-energy electrons. In this method, the ground state of the noble gas atom, after a collision with a fast electron, was considered to lose one of its valence electrons in a time shorter than the relaxation time of the atom. The resulting configuration was then assumed to be a $|(p^5)^2\,P_J\rangle$ state with $J = 3/2$ or $1/2$, with the remaining valence electrons having the same radial coordinates as the original $|(p^6)^1S_0\rangle$ state of the neutral atom. The configuration $|(p^5)^2P_J\rangle$ was then expanded in terms of the ionic wave functions having the form of $|(p^4)\overline{L}\overline{S}, nl', LSJ\rangle$, where $\overline{L},\overline{S}$ designated the total orbital angular momentum and the total spin angular momentum of the core electrons, l' was the orbital angular momentum of the excited running electron, and LSJ designated the final orbital, spin, and total angular momenta of the atom. The coefficients of the expansion were calculated in terms of the coefficients of fractional parentage and 3-j symbols. The radial wave functions for the neutral atoms and their excited ionic states for the involved radial integrals were obtained by using a computer program giving the self-consistent Hartree–Fock wave functions in the Slater approximation. Since no experimental measurements for the excitation cross sections with fast electrons were given, the results of the calculations were indirectly compared with the available work reported on the pulsed Ar II laser. Population of various excited ionic states was calculated assuming a uniform energy distribution of electrons having 1.8 times the ionization threshold of Ar, and the results were compared with experimental data reported in the literature. (BBB)

23000 ON THE SOLUTION OF THE QUANTUM MECHANICAL TWO-ELECTRON PROBLEM BY DIRECT CALCULATION OF THE NATURAL ORBITALS. IV. APPLICATION TO THE GROUND STATE OF THE HYDROGEN MOLECULE IN A ONE-CENTER EXPANSION. Ahlrichs, R.; Kutzelnigg, W.; Bingel, W. A. (Univ., Goettingen, Ger.). Theor. Chim. Acta, 5: 305-11(1966).

The wave function of the ground state of the H_2 molecule was calculated directly in its natural expansion form, the approximate natural orbitals (NO) being expressed as linear combinations of Slater type functions centered at the midpoint of the molecule. The results gave as total energy (in the equilibrium distance) 1.168 Å (exact 1.174 Å) which is proposed to be the best one-center result for H_2 known so far; 96% of the binding energy is accounted for. The accuracy of this approach is limited due to the rather slow convergency of the one-center expansion of the orbitals. The Hartree–Fock (HF) energy calculated with the same basis (1.129 Å) is about as much in error with respect to the exact HF energy (1.136 Å) as the energy of the NO expansion with respect to the experimental one. (BBB)

23001 THERMAL DESORPTION OF INERT GASES IONICALLY PUMPED INTO GLASS. Grant, W. A.; Carter, G. (Univ. of Liverpool). Phys. Chem. Glasses, 8: No. 1, 35-7(Feb. 1967).

When energetic inert gas ions are impelled into glass surfaces they become captured within the glass matrix, but can be released back into the gas phase by heating the glass. Studies of the temperature dependence of the release rates suggest that the ions are located near to the glass surface and held in a variety of trapping centres possessing different activation energies for desorption. It is believed that these centres are produced by displacement of glass atoms from their normal positions by the ion irradiation, and experimental evidence for these hypotheses is presented and examined. (auth)

23002 STATIC QUADRUPOLE FIELD FOR THREE-DIMENSIONAL STABILIZATION OF ELECTRONS. Kleinpoppen, H.; Schumann, J.-D. (Univ., Tuebingen, Ger.). Z. Angew. Phys., 22: 152-5(1967). (In German).

An experimental arrangement is described which enables electrons to be stabilized in a volume of a few cubic centimeters. In order to stabilize the electrons the following electrostatic and magnetostatic fields are applied: an electrostatic quadrupole field of cylindrical symmetry, and a homogeneous magnetostatic field parallel to the direction of symmetry. Formulas are given for the stability of the electron trap described. Lifetimes of the electrons in the trap are measured as a function of different parameters (magnetic field, gas pressure). (auth)

23003 REVIEW OF RECENT WORK IN THE DETERMINATION OF FUNDAMENTAL PHYSICAL CONSTANTS. Cohen, E. R. (North American Aviation, Inc., Thousand Oaks, Calif.). Nuovo Cimento, Suppl. (1), 4: 839-62(1966).

The experimental data which formed the basis of the 1963 adjustment of the fundamental physical constants are reviewed and the data which have become available since then are summarized. Several experiments are mentioned for which numerical results are not yet available. The more significant areas of current activity in the determination of the values of the physical constants are pointed out. The fundamental constants along with the conversion factors and auxiliary constants which are of vital importance in the determination of the fundamental constants are discussed. (W.D.M.)

23004 EMPIRICAL RELATIONS FOR ABSORPTION OF POSITRONS AND ELECTRONS IN SOLIDS. Takhar, P. S. (Royal Millitary Coll. of Canada, Ontario). Brit. J. Appl. Phys., 18: 246-8(Feb. 1967).

Data on the absorption of 1.88 MeV positrons and 1.77 MeV electrons were found to fit an empirical relation between the "equivalent thickness" t (in units of mg cm^{-2} × Z/A) (for a given transmission) and the atomic number Z, of the form $t^4(T) = a \exp(mZ^4)$. (auth)

23005 BOUND–FREE ABSORPTION COEFFICIENT OF THE NEGATIVE HYDROGEN ION. Bell, K. L.; Kingston, A. E. (Queen's Univ., Belfast). Proc. Phys. Soc. (London), 90: 895-9 (Apr. 1967).

The method of polarized orbitals has been employed to obtain a representation of the singlet P-wave continuum functions of the negative hydrogen ion. These functions were combined with twenty- and seventy-parameter bound-state wave functions to calculate the bound–free absorption cross sections of the negative hydrogen ion using the length and velocity alternatives for the dipole operator. It is found that the results of Geltman [Astrophys. J., 136: 935-45(1962)], Doughty, et al. [Mon. Not. R. Astr. Soc., 132: 255-66(1966)], and the present calculations in the length formulation are in close agreement, but that there is a considerable disparity at long wavelengths between these results and the experimental photodetachment results of Smith and Burch [Phys. Rev. Letters, 2: 165-6(1959a)] and of Branscomb and Smith [Phys. Rev., 98: 1028-34(1955)]. (auth)

23006 SPHEROIDAL WAVE FUNCTIONS FOR THE HYDROGEN ATOM. Coulson, C. A.; Joseph, A. (Mathematical Inst., Oxford). Proc. Phys. Soc. (London), 90: 887-93(Apr. 1967).

The Schrödinger equation for a hydrogen atom can be solved in spherical polar, parabolic, and spheroidal coordinates. Relations between these types of solution are obtained by an algebraic method depending on the existence of an extra constant of the motion for the two-centre Kepler problem. Limiting conditions and certain orthogonality relations are studied. It is shown that, in Fock's method of stereographic projection of momentum space on to the surface of a four-dimensional hypersphere, an orthogonal coordinate system cannot be found to separate the equations of motion corresponding to the use of spheroidal coordinates in configuration space. This is in marked contrast with the situation with spherical polar and parabolic coordinates. (auth)

23007 AN ACCURATE SPUTTERED SPOT PATTERN MONITOR. Chapman, G. E.; Kelly, J. C. (Univ. of New South Wales, Kensington, Australia). J. Sci. Instrum., 44: 261-4 (Apr. 1967).

An apparatus is described which enables the formation of sputtered spot patterns to be continuously monitored and photographed. Provision is also made to enable the single crystal target to be rotated and tilted to present any orientation to the incident ion beam. The target crystal temperature can be varied from liquid nitrogen temperature to several hundred degrees. The equipment has been used to study the temperature and incident ion energy variation of sputtered spot patterns from gold single crystals. The photographic records of the developing spot pattern are measured by microdensitometry. The microdensitometer is calibrated with a standardizing sector disk using thin films of gold whose thickness is measured by high resolution multiple beam interferometry. (auth)

23008 BETA PARTICLE BACKSCATTERING. Bustard, Thomas S. (Hittmann Associates, Inc., Baltimore); Silverman, Joseph. Nucl. Sci. Eng., 28: 55-61(Apr. 1967).

An analysis is performed which indicates that beta particle backscattering measurements are highly sensitive to source-scatterer separation distances. It is shown that the primary betas emitted by the source strike the scatterer according to a Cauchy statistical distribution. Then, making the assumption that the primary betas are adsorbed on the scatterer and isotropically reemitted, an effective counting geometry can be obtained. A comparison of this effective geometry with the source geometry will then give an indication of the expected backscatter signal sensitivity. It is shown that a 50-mil separation distance can result in a backscatter measurement error of 25%. Zumwalt's empirical relation for saturation backscattering is used to analytically predict the expected normalized (source signal equal to one) signal as a function of source-scatterer separation distance and scatterer atomic number. Finally, Al, Ni, Nb, Pd, and Ta scatterers are employed using ^{204}Tl and ^{32}P beta sources in conjunction with a thin-window halogen-quenched G–M tube to compare experimental and analytical results. This experiment shows that Zumwalt's equation provides an excellent fit to the experimental results in all instances except when employing the low atomic number scatterer, Al. (auth)

23009 ELECTRON BEAMS: NATIONAL BUREAU OF STANDARDS AND THE NEW TECHNOLOGY. Koch, H. W. Science, 156: 321-8(Apr. 21, 1967).

Applications of electron beams have been revolutionized by recent improvements in the production, detection, and utilization of high-energy electrons. These improvements are the basis of an era of expansion of the application of electrons to physics, chemistry, biology, and the applied sciences that may be as significant as the era of neutron applications in the atomic-energy technology 20 years ago. The new electron-beam technology, with particular emphasis on the present and future roles of the National Bureau of Standards, is discussed. (TSS)

23010 NEW DATA ON EFFECTIVE CROSS SECTIONS OF NEON EXCITATION LEVELS. Zapesochnyi, I. P.; Fel'tsan, P. V. Zh. Prikl. Spektrosk., Akad. Nauk BSSR, 6: 111-12(Jan. 1967). (In Russian).

Results are given from experimental studies of the cross sections of ten 2p neon levels excited by low-energy electrons for $2p_4$, $2p_6$, $2p_8$, $2p_9$, $2p_{10}$ levels, correction for cascade transitions being taken into account. The peculiarity of $2p_{10}$ level is the presence of the sharp maximum just at the threshold. (auth)

23011 OVERLAP INTEGRALS AND r-CENTROIDS OF $D^1\Delta \rightarrow A\ ^1\Pi$ SYSTEM OF MgO. Srivastava, Y. P.; Maheshwari, R. C. (Univ. of Gorakhpur, India). Proc. Phys. Soc. (London), 90: 1177-8(Apr. 1967).

The squares of the overlap integrals $|\int \psi_{v'} \psi_{v''} dr|^2$ and r centroids $\bar{r}_{v',v''}$ of the $D\ ^1\Delta \rightarrow A\ ^1\Pi$ system of MgO, which is of astrophysical interest for disk and spot spectra of the sun, were evaluated. (auth)

23012 THEORY OF A LOW-DENSITY BOSE LIQUID. Amit, D. J.; Gross, E. P. (Brandeis Univ., Waltham, Mass.). Ann. Phys. (N. Y.), 42: 296-314(Apr. 1967).

A many-body system of Bose particles, interacting via short-range repulsion and long-range attraction is considered. Both repulsion and attraction are weak. It is shown that, with a suitable choice of interaction parameters, one obtains a consistent low-density liquid using a slightly modified Bogolyubov treatment. The refinement of the elementary theory affects only the very long wavelength phonons, and is essential in order for the phase velocity of these phonons to agree with the speed of sound calculated from the compressibility. The weakness of the interaction makes it possible to control the consistency of the calculation. Nevertheless, passage to the limit of pseudopotential repulsion is direct, and one can establish the relation to an earlier model studied by Huang. (auth)

23013 PERTURBATION THEORY FOR RESONANCES OF THE FESHBACH TYPE. Mandl, F. (The Univ., Manchester, Eng.). Proc. Phys. Soc. (London), 90: 913-24(Apr. 1967).

A Feshbach resonance consists of a particle temporarily bound to an excited state of a complex target. For the case of a two-electron system, a perturbation theory is developed for the associated complex resonance energy, as defined by Siegert [Phys. Rev., 56: 750-2(1939)], by treating the coupling responsible for the emission of a particle as small. The resulting expressions for the width and energy shift agree with Feshbach's results [Ann. Phys., N. Y., 5: 357-90(1958) and 19: 287-313(1962)]. (auth)

23014 ENERGY CALCULATION OF THE METASTABLE $(1s2s2p)^4P^0$ STATE OF He^- AND Li. Holoeien, E.; Midtdal, J. (Oslo Univ.). Proc. Phys. Soc. (London), 90: 883-4(Mar. 1967).

Owing to a mistake in algebra made by Holøien and Midtdal in 1955 [Proc. Phys. Soc. A, 68: 815-23] when evaluating the matrix elements of the kinetic energy part of the Hamiltonian operator, the numerical values obtained for the energy and the coefficients of the corresponding eigenvector are in error. The error is associated only with correlated basis functions because the correction term vanishes for those which are noncorrelated. The corrected values obtained by the re-examination for lithium are more consistent with recent results from electron-impact experiments. New results for the energy and the corresponding eigenvector are given for a 15th-order subset both for He^- and Li. (auth)

23015 METHOD OF CALCULATION OF BACK-SCATTERING GAMMA RADIATION. Bulatov, B. P. At. Energ. (USSR), 21: 345-56(Nov. 1966). (In Russian).

Formulas and graphs, making it possible to calculate the energy flux density of back-scattered γ radiation of some widely used isotopes (^{60}Co, ^{137}Cs, ^{198}Au, and ^{51}Cr), were given for typical cases, for example: narrow and wide beams of γ quanta, incident at different angles on the surface of the scattering medium; isotropic sources existing in contact with the surface of a reflector. The accuracy of the calculations with respect to the proposed formulas is ±20%. The present method is the first attempt to obtain engineering formulas and nomograms for the determination of the amount of scattered γ radiation. (tr-auth)

23016 RELATIVISTIC EFFECTS IN CHEMICAL BONDING: THE H_2^+ MOLECULE. Pavlik, P. I.; Blinder, S. M. (Univ. of Michigan, Ann Arbor). J. Chem. Phys., 46: 2749-51(Apr. 1, 1967).

The behavior of the electron in the ground state of the hydrogen molecular ion is examined using the Dirac theory. Since the resulting set of equations is not readily separable, the variational theorem is applied to obtain approximate eigenfunctions for the ground state. Trial variational functions having the same symmetry properties as the exact solution can be conceptualized as a superposition of functions closely resembling nonrelativistic molecular orbitals. The relativistic correction to the electronic energy is approximately -7×10^{-6} a.u. (auth)

23017 CALCULATION OF THE PHOTOIONIZATION CROSS SECTION OF Au AND Bi ATOMS IN THE REGION OF VERY

SOFT X RAYS. Farnoux, Francoise Combet; Heno, Yvonne (Faculte des Sciences, Paris). Compt. Rend., Ser. B, 264: 138-41(Jan. 9, 1967). (In French).

Calculations of the photoionization cross sections were made in a free atom model; they show that important variations of the massive absorption coefficients of Au and Bi found in experiments in the energy range from 80 to 350 eV are due to the combined effects of the subshells 4f, 5s, 5p, 5d, 6s. (tr-auth)

23018 EFFECT OF COLLISIONS ON THE DOPPLER BROADENING OF SPECTRAL LINES. Rautian, S. G.; Sobel'man, I. I. Usp. Fiz. Nauk, 90: 209-36(Oct, 1966). (In Russian).

This is a review article devoted to a detailed analysis of the effect of collisions on Doppler broadening and to the relation of impact broadening on the Doppler effect. The general treatment of the effect of collisions on pure Doppler broadening is first discussed, neglecting possible interference with the vibrations of the oscillator. Other causes of broadening, such as radiative decay, broadening due to interaction of the emitting atom with the surrounding particles, are then discussed, followed by a simultaneous account of radiative decay and the Doppler effect. Although the effect of collisions on pure Doppler broadening is of interest in a number of physical problems, it has been discussed in the past only within the framework of the Brownian movement model. Consequently, the authors expand on this model and treat Doppler broadening also by the kinetic equations method. Two types of collisions are treated, those in which the phase and velocity change simultaneously, and those in which either the phase alone or the velocity alone changes. The broadening due to the interaction and to the Doppler effect is discussed both under the assumption that they are statistically independent and under the assumption that they are statistically dependent. The possibility of experimentally testing the theory developed is discussed. It is indicated that the results obtained can be extended to a broad class of nonlinear problems, including calculations of the intensity of laser action. The results obtained by A. Javan and A. Szoke (Phys. Rev. Letters, Al6: 12(1966)) are shown to confirm the conclusion that the Doppler and impact mechanisms are statistically dependent for both strong and weak collisions. (ATD)

23019 PROBABILITIES OF ELECTRON VIBRATIONAL TRANSITIONS IN DIATOMIC MOLECULES. Ortenberg, F. S.; Antropov, E. T. (Lebedev Inst. of Physics, Moscow). Usp. Fiz. Nauk, 90: 237-73(Oct, 1966). (In Russian).

This is a review article devoted to the advances made in quantitative studies of the distribution of intensity in spectra of diatomic molecules and radicals during the last decade, with special attention to more rigorous methods of calculations, to modernization of the experimental techniques, to various shortcomings of the customarily employed Franck–Condon principles, to new calculations of the Franck–Condon factors, and to the dependence of the dipole moment of the electron transitions on the internuclear distance. The results of all the presently known calculations of the dipole moment of transitions for different internuclear distances are first summarized. Calculation of the Franck–Condon factors by means of various models is then discussed and an extensive table of electronic transitions in diatomic molecules for which the Franck–Condon factors have been calculated is presented. Experimental methods of measuring the transition probabilities are described, with emphasis on shock-tube techniques. The dependence of the electron-transition moments on the interatomic distance is analyzed and the data obtained by the r-centroid method are tabulated. Some numerical results presently known for air, O_2, NO, and N_2 are presented. (auth)

23020 PART PLAYED BY SECOND-ORDER COLLISIONS IN THE RADIATION OF MOLECULAR BANDS OF N_2, AND N_2 + Ar AND CO + Ar MIXTURES IN A GLOW DISCHARGE. Chernenko, L. A. (Siberian Physical-Technical Inst., Tomsk, USSR). Izv. Vyssh. Ucheb. Zaved., Fiz., No. 5, 67-70(1966). (In Russian).

The investigation of second-order impacts in glow discharges is complicated by a variety of secondary processes that affect the radiation intensity. To localize the role of second-order impacts, the energy levels of N_2 and Ar in N_2 + Ar and CO + Ar mixtures were compared; the comparison was made of the intensity of bands exposed to second-order impacts and that of bands that behave similarly during excitation but are not exposed to second-order impact. The partial pressure of Ar was varied from 0 to 1.98 mm Hg. The magnitude of the relative intensity (I) was related to the intensity of the same band in pure nitrogen (I_0). Thus, the amplification factor $\kappa = (I/I_0)(n_0/n)$ was obtained, where n_0 is the number of particles in pure N_2 and n is the number of particles in the mixture. The amplification factors coincided for bands starting from the same level. The absolute error of the measurement of κ is 0.1. The bands that start at the third oscillating level increased more than all other bands; the bands starting at the second level showed a lesser increase. Identical experiments were performed with the CO + Ar mixture, including the measurement of temperature and of the electron concentration in mixtures of various compositions. It was found that $\kappa_{exp} > \kappa_{cal}$, apparently because κ_{exp} includes amplifications produced by both changes in excitation conditions and changes on account of second-order impact. The amplification curve, which is plotted, can be used for calculating the effective cross section of second-order impact. (ATD)

23021 LECTURES IN THEORETICAL PHYSICS. VOLUME VIII A. STATISTICAL PHYSICS AND SOLID STATE PHYSICS. Lectures Delivered at the Summer Institute for Theoretical Physics, University of Colorado, Boulder, 1965. Brittin, Wesley E. (ed.). Boulder, Colo., University of Colorado Press, 1966. 361p. $7.00.

Lectures included are on quantum theory of measurement, statistical mechanics of moderately dense gases not in equilibrium, kinetic equations for quantum systems, rigorous results in nonequilibrium statistical mechanics, orbital magnetism, theory of spin–lattice coupling effects, solid state scattering theory, and electron collision effects in semiconductors. A separate abstract was prepared for one paper on the statistical mechanical basis of magnetohydrodynamics. (A.G.W.)

For an abstract of the individual paper see: 23057.

23022 YIELD, ENERGY, AND ANGULAR DISTRIBUTIONS OF SPUTTERED ATOMS. Weijsenfeld, C. H. (Univ., Utrecht). Philips Res. Rep. Suppl., No. 2, 1-112(1967).

Thesis.

Experiments were carried out with rare gas ions (100 to 2000 eV) normally incident on mono- and polycrystalline metal surfaces. Sputtering yield, average atom energy, and angular distributions were measured. The interpretation is concentrated on the ejection mechanism of a surface atom. A general review of the problem and its interest are given; the apparatus used is described. The principles of the detection techniques as well as some testing and checking experiments on the detectors are described. The number of atoms sputtered in a certain ejection direction was directly read from the decreasing resistance of a depositing film of sputtered metal atoms. Based on this principle a rapid, sensitive and simple detector system with a linearized output was developed. The average energy of the sputtered atoms was deduced from the temperature rise of a small collector suspended by thermocouple wires. Both detectors can be turned about the sputtering target during bombardment so as to measure angular distributions. The results of the measurements are given. For several metals the total sputtering yields have been determined as functions of the rare-gas-ion energy (100 to 1000 eV). The sputtering yield and the average atom energy for atoms sputtered in the direction normal to mono- and polycrystalline copper surfaces have been determined as functions of the krypton-ion energy (100 to 2000 eV). Yield and average energy of atoms sputtered from various copper and silver monocrystals have been determined as functions of the polar and azimuthal angle of ejection for 1-keV krypton-ion bombardment. These angular distributions show strongly preferred ejection directions corresponding to close-packed lines of atoms in the crystal. They originate from so-called focusing collision sequences travelling in those close-packed directions. The interaction potential between atomic particles and the binding of atoms to their lattice sites in the solid state are discussed. Then two possible kinds of focusing collision sequences are treated and the situation of a surface atom is described. Various measured shifts between ejection maxima and close-packed directions may be quantitatively understood on the basis of repulsive and attractive forces between the ejected atom and its neighbours at the surface. A comparison between various shifts and energies for copper and silver leads to a conclusion about the atomic-number (Z) dependence of the interaction potential. Finally, the angular widths of the various ejection maxima measured in different directions are in good agreement with a calculation based on thermal vibrations of the surface atoms of the crystal (or, the measured widths show that the vibrational amplitude of surface atoms is anisotropic). (auth)

23023 IONIZATION AVALANCHES AND BREAKDOWN. Llewellyn-Jones, F. New York, Barnes and Noble, Inc., 1967. 109p. $2.50 paper; $4.50 cloth.

Recent theoretical and experimental developments in the study of the electrical breakdown of gases are given. In addition to discussing the results of applying modern time-resolving techniques, there is a detailed analysis of the studies of avalanche growth and the investigation of atomic and ionic collisional processes, using methods based upon the temporal growth and decay of ionization currents. Recent work on electrical breakdown at high values of the spark parameter (>4000 torr. cm) is discussed and an account is also given of the mechanisms of so-called vacuum breakdown. (M.H.R.)

Cosmic Radiation

Refer also to abstracts 23080, 23120, and 23345.

23024 (AD-641174) BALLOONING SUPPORT FOR COSMIC-RAY EXPERIMENTS. Kubara, Robert S.; Stiller, Bertram (National Center for Atmospheric Research, Boulder, Colo.). Sept. 1966. 76p. (NCAR-TN-20). CFSTI $3.00 cy, $0.65 mn.

The National Center for Atmospheric Research organized and provided program management for a balloon expedition to study cosmic rays in the vicinity of the equator during the International Quiet Sun Year (IQSY). A joint United States–India activity, the program was conducted in Hyderabad, India during the late winter and early spring of 1965. A total of 17 flights were scheduled during the period March 6 to April 9, 1965. Of these, 13 were successful, three were ground failures, and one balloon burst during ascent. The heaviest payload flown weighed 2858 lb. All scientific packages scheduled were successfully flown and recovered. (auth)

23025 (AECL-2663) COSMIC RAY NM-64 NEUTRON MONITOR DATA-IV, MAY-AUGUST 1966. Monthly Graphs, January 1966-August 1966. Steljes, J. F. (Atomic Energy of Canada Ltd., Chalk River (Ontario)). Sept. 1966. 74p. (CRGP-1244). Dep. mn. CFSTI $3.00 cy, $0.65 mn. AECL $2.00.

Uncorrected and barometer-corrected results from the cosmic-ray stations at Deep River, Alert, Goose Bay, and Inuvik are given in tabular form for the period from May to August 1966. Normalized graphs are given for the period January 1966 to August 1966. (W.D.M.)

23026 (NP-16628) SCIENTIFIC CONTRIBUTIONS OF SPACE PHYSICS GROUP. (Universidad Mayor de San Andres, La Paz (Bolivia). Laboratorio de Fisica Cosmica de Chacaltaya). 1965. 71p. Dep. mn.

Separate abstracts were prepared on the three sections of the report. Work is reported on solar daily variation, effects of the deformed magnetic field of the earth on medium energy cosmic rays, and transient anisotropy during the recovery phase of a Forbush decrease. (W.D.M.)

For abstracts of individual sections see: 23027–23029.

23027 (NP-16628, pp 1-9) SOLAR DAILY VARIATION RECORDED AT A LOW LATITUDE STATION BY EAST AND WEST POINTING TELESCOPES DURING A PERIOD OF MAXIMUM AND MINIMUM IN SOLAR ACTIVITY. Ahluwalia, H. S.; Escobar, V. I.; Zubieta, M.; Anda, R.; Schreier, M.; Troncoso, O. (Universidad Mayor de San Andres, La Paz (Bolivia). Laboratorio de Fisica Cosmica de Chacaltaya).

The characteristics of solar daily variation recorded by east and west pointing directional telescopes at Mt. Chacaltaya (alt = 5200 m, geomag lat = −4.8°) during the years of maximum (1958) and minimum (1964) in solar activity in the last solar cycle were examined. It was found that the amplitude of the diurnal component, both in the east as well as in west directions, was reduced in 1964 compared to its value in 1958. The time of maximum of the diurnal component in the two directions has, however, the same value in the two years within errors of observations. The results of diurnal component are compared with those obtained with neutron monitors, at other equatorial mountain level stations of Huancayo and Mt. Norikura for the same period as well as with the parameters defining the diurnal component at Huancayo in the years 1937 to 1954 as obtained by an ion chamber. It is concluded that the basic periodicity in the parameters defining the diurnal component of solar daily variation is of 22 years rather than of 11 years. (auth)

23028 (NP-16628, pp 10-31) CHARACTERISTIC EFFECTS OF THE DEFORMED MAGNETIC FIELD OF THE EARTH ON MEDIUM ENERGY COSMIC RAYS. Ahluwalia, H. S. (Universidad Mayor de San Andres, La Paz (Bolivia). Laboratorio de Fisica Cosmica de Chacaltaya); McCracken, K. G. (Southwest Center for Advanced Studies, Dallas, Tex.).

A study is presented of the characteristic effects of the deformed magnetic field on the trajectories and asymptotic directions of arrival of medium-energy cosmic rays at three representative stations: Chacaltaya, Deep River, and London. For this purpose a spherical harmonic description of the deformed magnetic field was superposed on a Störmer dipole and Finch and Leaton higher degree simulation field configurations. It was found that asymptotic directions of arrival for deformed fields are considerably different from those for undisturbed fields at lower rigidities and the mean deviation at each station is larger for night than for day hemisphere. Evidence of a strong modulation of penumbral bands by the deformed field was found. There is an indication that small semidiurnal component, at equatorial stations, results from the deformation of the terrestrial field. The resulting component is however, an order of magnitude smaller than that observed on many occasions at low latitude stations. (auth)

23029 (NP-16628, pp 32-60) A CASE OF TRANSIENT ANISOTROPY DURING THE RECOVERY PHASE OF A FORBUSH DECREASE. Ahluwalia, H. S. (Universidad Mayor de San Andres, La Paz (Bolivia). Laboratorio de Fisica Cosmica de Chacaltaya).

On July 18, 1959 a short-lived highly anisotropic cosmic-ray increase was observed by some of the I.G.Y. network of recording stations during recovery from the third of the series of three closely spaced Forbush decreases. Characteristic features and the solar and terrestrial relationships of this increase are studied. Mechanisms proposed thus far for this increase are critically examined. Arguments are presented to the effect that this could not be a solar flare-type increase. It is suggested that this increase was probably produced by galactic cosmic rays which got reflected from receding blast wave and co-rotating shock wave formed during the explosive heating of solar corona following the west limb 3^+ solar flare of July 16, 1959. The corresponding features of associated heliophysical, geophysical, and cosmic-ray phenomena were studied; the velocity of the blast wave was found to be 1700 km/s and its total thickness about 0.14 au. It appears that this blast wave had considerable fine structure built into it. There is some evidence that this blast wave probably started to dissolve into background solar wind at a distance of about 1.5 au from the sun. (auth)

23030 RADIOACTIVE NUCLIDES INDUCED BY SOLAR COSMIC RADIATION IN CHONDRITES. Yokoyama, Yuji; Mabuchi, Hisao (CNRS, Gif-sur-Yvette, France). Compt. Rend., Ser. B, 264: 655-7(Feb. 20, 1967). (In French).

Up to the present it was thought that the radioactive nuclides induced by cosmic radiation were due only to galactic cosmic radiation. It is shown in the present study that several short-lived radioactive nuclides such as ^{51}Cr and ^{45}Ca are produced by the secondary neutrons due to solar cosmic radiation. (tr-auth)

23031 RADIO EMISSION OF EXTENSIVE AIR SHOWERS (EAS) OF COSMIC RAYS. Vernov, S. N.; Abrosimov, A. T.; Volovik, V. D.; Zalyubovskii, I. I.; Khristiansen, G. B. (Moscow State Univ. Kharkov State Univ.). JETP Lett. (USSR) (Engl. Transl.), 5: 126-30(Mar. 1, 1967).

Translated from Zh. Eksp. Teor. Fiz., Pis'ma Redaktsiyu, 5: 157-62(Mar. 1, 1967).

Following a number of theoretical and experimental investigations, the comprehensive experimental setup of the Nuclear Physics of the Moscow State University was used to study the lateral distribution of radio emission from extensive air showers. A block diagram of the experimental setup is shown. A detailed description of the comprehensive apparatus was given previously. Radio emission from the showers was registered for 1100 hours. A complete analysis of the registered radio pulses was made for the last 400 hours. In 400 hours of operation 27 EAS, accompanied by a power flux exceeding the cosmic-noise power flux by five times or more, was registered. During the remaining 700 hours 17 EAS were observed, with a power flux exceeding the cosmic-noise flux by 25 times. (W.D.M.)

23032 WORLDWIDE TRAJECTORY-DERIVED VERTICAL CUTOFF RIGIDITIES AND THEIR APPLICATION TO EXPERIMENTAL MEASUREMENTS. Shea, M. A.; Smart, D. F. (Air Force Cambridge Research Labs., Bedford, Mass.). J. Geophys. Res., 72: 2021-7(Apr. 1, 1967).

Since the advent of high-speed digital computers, the trajectory-tracing process has been employed by several researchers to calculate the cutoff rigidity for specific locations of geophysical interest. For the past year, this method was used to produce a grid of vertical cutoff rigidities for each 5° in latitude and 15° in longitude. This method utilizes the Finch and Leaton sixth-degree simulation of the quiescent geomagnetic field and considers rigidity intervals as small as 0.01 bV to include effects of the penumbra. When cosmic-ray threshold rigidities interpolated from this grid are used to order cosmic-ray intensity data, excellent coherence of the data is obtained even in magnetically anomalous areas. Examination of the data for several latitude surveys shows that for any specific year, the data are grouped in a single general curve, but when the data from different years are compared, time changes due to modulation of the primary cosmic-ray spectrum are apparent. However, slight variations noticeable in very precise experimental measurements are indicative of the fact that a limitation was reached in using only vertical cutoff rigidities for ordering experimental data. Vertical cutoff rigidities for a 15 by 15° world grid are listed. (auth)

23033 COSMIC RAYS AND LARGE-DISTANCE FEATURES OF THE INTERPLANETARY SPACE. Bachelet, F.; Iucci, N.; Lanciani, P. (Univ., Rome. CNR, Rome). J. Geophys. Res., 72: 2007-9(Apr. 1, 1967).

The effect on cosmic rays of a static barrier possibly surrounding the region of the steadily expanding solar corona is studied at

high rigidities. The barrier could be formed at any distance where the solar wind is substantially decelerated and some turbulence is set in; its transparency might trace the solar activity with some delay, in agreement with the observations on the 11-year modulation of cosmic rays as recorded by the ground stations. (auth)

23034 REGISTRATION OF HEAVY IONS DURING THE FLIGHT OF GEMINI VI. Benton, E. V.; Collver, M. M. (Naval Radiological Defense Lab., San Francisco). Health Phys., 13: 495-500(May 1967).

Several small disks of cellulose nitrate plastic were included as a part of a passive dosimetry package aboard the Gemini VI spacecraft for the purpose of recording the heavy component of the solar and the primary cosmic radiation. An average of 230 tracks/cm^2 per day was observed. Of these about 70 tracks/cm^2 were background alpha particle tracks produced by natural radioactivity. About 159 tracks/cm^2-day were due to stopping alpha particles of solar and galactic origin; a few heavy recoil ion tracks were also observed. About one track/cm^2-day was judged to be due to the heavy primary cosmic ray particles. Relativistic iron nuclei apparently did not produce tracks in the cellulose nitrate. It appears that by stacking sheets of cellulose nitrate into sandwich configurations it is possible to provide a simple and direct means of measuring the integrated flux and energy spectra of solar alpha particles inside the manned spacecraft. (auth)

23035 ^{3}He NUCLEI IN THE LOW ENERGY PRIMARY COSMIC RADIATION. Biswas, S.; Lavakare, P. J.; Ramadurai, S.; Sreenivasan, N. (Tata Inst. of Fundamental Research, Bombay). Proc. Indian Acad. Sci., Sect. A, 65: 104-18(Feb. 1967).

The ^{3}He flux and the ratio $^3He/(^3He + ^4He)$ in the low-energy primary cosmic radiation were determined, using a stack of nuclear emulsions exposed at 3.1 g cm^{-2} of atmospheric depth from Fort Churchill, Canada, in June 1963. The grain density versus residual range method was used to determine the masses of the helium nuclei. Using a sample of 146 helium nuclei whose masses could be identified, the ratio $^3He/(^3He + ^4He)$ is obtained as 0.14 ± 0.04 for the kinetic energy interval 115 to 210 MeV per nucleon and 0.43 ± 0.11 for the rigidity interval 0.85 to 1.05 BV. The differential fluxes of ^{3}He nuclei are determined as 0.017 ± 0.006, 0.045 ± 0.015, and 0.054 ± 0.017 particles/M^2. Sr. Sec. MeV/nucleon, in the kinetic energy intervals of 117 to 183, 183 to 217, and 217 to 250 MeV/nucleon, respectively. These results are compared with those of other investigators. The amount of matter traversed in space by the primary cosmic-ray helium nuclei of energy 115 to 210 MeV/nucleon is obtained as 4.7 ± 1.8 gm cm^{-2} of hydrogen. (auth)

23036 TRACKS OF COSMIC RAYS IN PLASTICS. Fleischer, R. L. (General Electric Co., Schenectady, N. Y.); Price, P. B.; Walker, R. M.; Filz, R. C.; Fukui, K.; Friedlander, M. W.; Holeman, E.; Rajan, R. S.; Tamhane, A. S. Science, 155: 187-9(Jan. 13, 1967).

Cosmic-ray nuclei have been observed with the use of plastic track-detecting solids in satellites and high-altitude balloon flights. Nuclear emulsions in the stacks of plastic sheets allowed the positive identification of cosmic-ray nuclei as light as nitrogen. The most striking new information was the failure to observe relativistic iron nuclei, a result that has led to an advance in the understanding of track registration criteria. (auth)

Direct Energy Conversion

23037 (AD-641019) PRODUCTION OF HIGH-ENERGY ELECTRICAL IMPULSES WITH AN MHD GENERATOR. Quarterly Technical Summary Report, May 1-July 31, 1966. (Avco-Everett Research Lab., Everett, Mass.). Aug. 1966. Contract AF33(615)-2846. 13p. CFSTI $3.00 cy, $0.65 mn.

Discussions are presented on systems and components testing, burner testing, generator excitation testing, as well as a complete-configuration single-circuit power test. The resulting data from the excitation and power output tests indicate close agreement with the design parameters. The single-circuit power test was terminated at a magnet current of approximately 15,000 amperes and resulted in a maximum net power output of 11,000 kilowatts. During this period some problems were encountered, mainly with the older equipment, which required revisions to such items as pilot and igniter fuel systems, pilot cooling and the main fuel-nitrogen purge systems. Information is included on the modification to the igniter and pilot burners and to the channel inlet section, as well as the results of the complete configuration tests. (auth)

23038 (AERE-R-5030) OPTIMISATION OF MHD GENERATOR PARAMETERS IN AN MHD-REACTOR SYSTEM. Rice, G. (Atomic Energy Research Establishment, Harwell (England)). Feb. 1967. 72p. Dep. mn. CFSTI $3.00 cy, $0.65 mn. HMSO 10s.

A study of the basic parameters of an MHD generator related to limits imposed by reactor design is described. The reactor coolant temperature is considered to be limited to the range 1600 to 2000°K. Increased gas pressure normally implies reduced reactor plant size. In an MHD plant, however, increased gas pressure will result in reduced specific power for which a lower limit of 5 to 10 MW/m^3 is assumed. The theory used assumes extra thermal ionization due to enhanced electron temperature. Computed values of power density and electrical conductivity of the MHD plasma were undertaken for varying magnetic field strength from 1 to 8 Wb/m^2. The noble gases helium and argon, with potassium, and cesium seeding, were considered, for a temperature range of 1010 to 2000°K and varying "total head" gas pressure. Plots of the computed results indicate the effect of varying seed ratio, and derived optimum values are related to those of gas discharge experiments. (auth)

23039 (STI-PUB-128(Vol.2)) ELECTRICITY FROM MHD. VOL. II. Proceedings Series. Proceedings of a Symposium held in Salzburg, 4-8 July 1966. (International Atomic Energy Agency, Vienna (Austria)). Nov. 1966. 1175p. (CONF-660704-Vol. 2). IAEA: $24.00; S 620,-; Pound 8.9.4; F Fr 117.60; DM 96,-.

The proceedings show the substantial progress made in MHD generator development, in particular the advances in high-temperature materials, the development of large, high-intensity, superconducting magnets, and the improved understanding of the detailed behavior of such systems under various operating conditions. This volume (II) contains papers from the closed-cycle and liquid metal sessions, under such categories as non-equilibrium theory and measurements, conformal mapping and electrode leakage, flow and nonequilibrium ionization, closed-cycle experiments, flows and method of liquid acceleration, generators, and overall cycle considerations. Separate abstracts were prepared for the papers and they appeared in NSA Vol. 20 numbers 21 and 22. Volume III is in preparation. (W.D.M.)

23040 NUMERICAL SOLUTION FOR A PROBLEM ON THE BOUNDARY LAYER OF A NONCONDUCTING SURFACE IN A MAGNETOHYDRODYNAMIC CHANNEL. Lobanova, L. F. Izv. Akad. Nauk SSSR, Mekh. Zhidkosti Gaza, No. 2, 3-7(Mar.-Apr. 1967). (In Russian).

Calculations were made of the temperature, velocity, and electric current profiles in the boundary layer and the resistance friction and heat exchange coefficients on the insulator wall of the channel. The magnitude of the coefficients as a function of the load parameter was investigated. (R.V.J.)

23041 HARNESSING AN ELECTRIFIED WIND. Yerrell, J. S. (English Electric Co., Ltd., Stafford, Eng.). New Sci., 3: 615-17 (Mar. 23, 1967).

The technique referred to as "electrogasdynamics" (EGD) is discussed, and it is considered to hold promise as a simple source of high-voltage direct current and may prove of commercial value. An historical introduction to the subject is included. The working principles of an EGD generator are simple. Basically, the generator consists of an insulating tube fitted with three electrodes—emitter, attractor, and collector. An auxiliary high-voltage supply is connected between emitter and attractor, and a high resistance connects collector to emitter. A gas stream carrying dust or aerosol particles flows down the tube from emitter to collector. The section of the tube between emitter and attractor serves to charge the particles. The moving gas stream carries most of the charged particles past the attractor and towards the collector, where discharge occurs and a current flows into the external circuit. The electric field set up in the tube between collector and emitter tries to force the particles back against the flow, and it is in overcoming this electrostatic force that the gas stream does work. The thermal and kinetic energy of the gas are converted into electricity. The required heat source could be a high-pressure combustion chamber or a high-temperature gas-cooled reactor. A difference from the magnetohydrodynamic (MHD) principle is that there is no lower temperature limit on EGD. The method by which charged carriers are produced does not rely on thermal ionisation, hence the outlet of an EGD generator can be at room temperature. This means that the full temperature range of the heat source can be used in the one machine. The problems of heat exchange and seeding are also obviated. Practical difficulties are discussed. These include the difficulty of producing high concentrations of charged particles of single polarity—also severe space charge effects. Laboratory set-ups are described. A 5 watt EGD generator is available commercially, and work is in progress on a 400-watt, 140-kV generator. An oil-fired 100-kW prototype is being built, designed for 140-kV. No spectacular advances in materials technology are needed. The systems improve in performance when used under high pressures. Control of the generator by feedback control of the corona excitation current is being considered. (UK)

23042 POSSIBILITY OF TRANSFER OF ELECTRICITY IN A THERMIONIC CONVERTOR BY NEGATIVE IONS. Keller, K.; McDonald, H. L. (Univ. of Arizona, Tucson). Advanced Energy Convers., 7: 113-20(Apr.-June 1967).

The transfer of electrons from the emitter or space-charge region to the collector in a thermionic energy convertor by negative ions was experimentally investigated. The region between the emitter and collector is filled with a low-pressure gas whose molecules attach electrons in the space charge or become negative ions after contact with the emitter. The negative ions move to the collector by diffusion and mutual repulsion, or convective flow, where they deposit their electrons by collisional detachment. The strongly electron-attaching gases, Br_2, CF_2Cl_2, and SF_6, were studied, but they did not undergo collisional detachment and reacted with the tungsten emitter. The inert gases, He and Ar, had little or no effect on the collector current and were used for comparison. Very pure CH_4 increased collector current by a factor of 10 or more. Experiments performed in a magnetic field showed that the collector current was due to the diffusion of negative ions as well as electrons. An experiment having a mass flow of methane over the emitter to the collector showed the transfer of electricity by negative ions. Photoionization or photodecomposition did not account for the negative-ion formation. The mechanism whereby CH_4 forms negative ions is unknown. (auth)

23043 IRREVERSIBLE THERMODYNAMICS OF HYDROMAGNETIC ENERGY CONVERSION. Osterle, J. F.; Farn, C. L. (Carnegie Inst. of Tech., Pittsburgh). Advanced Energy Convers., 7: 91-8(Apr.-June 1967).

The Onsager formalism of irreversible thermodynmics is applied to the steady-state laminar hydromagnetic energy convertor on both the local and global levels. The nature of the coupling on these two levels is studied. The global dissipation rate is obtained from the local entropy production rate and the coupling relations on the global level are established. The figure of merit for the convertor is determined as a function of Hartmann number of aspect ratio, and the maximum conversion efficiency is calculated. (auth)

23044 USE OF PHOTOIONIZATION IN DIRECT ELECTRICAL POWER GENERATION. Popescu, Iovitzu; Musa, G.; Popescu, A.; Baltog, A. (Inst. of Physics, Rumanian Academy of Sciences). Rev. Roum. Phys., 11: 925-35(1966).

The cesium atomic and molecular photoionization cross section in the principal series wavelength range is evaluated with the help of a thermionic detection method. The corresponding ionization rates are compared in terms of the cesium vapor pressure for a solar radiant energy distribution. It is concluded finally that the photoionization appears as a most promising nonequilibrium ionization process for plasma electrical power generators. (auth)

23045 THERMIONIC ENERGY CONVERTER. (to Radio Corp. of America). British Patent 1,064,794. Apr. 12, 1967. Priority date July 9, 1963, United States.

The principal object of the present invention is to provide a new, more reliable, and efficient thermionic energy converter for operation in the ball-of-fire mode. The converter includes: an envelope containing an ionizable alkali metal vapor; means to adjust the vapor pressure in the range 10^{-2} to 10 mm of Hg; a thermionic cathode for operation between 1000 and 2500°K, at which the effective work function of the cathode emissive surface is below the ionization potential of the vapor; and an anode capable of being cooled to an operating temperature below the cathode at which the effective work function of the anode is below that of the emissive surface. The cathode surface is provided with an array of recesses open toward the anode, the width and depth of the recesses being large compared to the minimum spacing between the cathode and anode. (auth)

23046 IMPROVEMENTS IN THERMOELECTRONIC ENERGY CONVERTERS FOR NUCLEAR REACTORS. (to CEA). British Patent 1,065,978. Apr. 19, 1967. Priority date Sept. 3, 1963, France.

The invention provides for a thermoelectric energy converter of the type comprising a plurality of elementary nuclear fuel bars of a nuclear reactor, an elementary anode surrounding coaxially each nuclear bar to form an elementary element, the anodes being connected to each other by connecting rings to form a tubular electrode on which the bars are mounted, the annular space between the bars and the anodes being filled with a plasma of a gas needing a low ionization energy, the converter being characterized in that the connecting rings consist of annular metal portions having a thickness less than that of the elementary elements so as to present an electrical resistance greater than that of the anodes. (W.D.M.)

Fluid Physics

Refer also to abstract 23041.

23047 (AD-643163) NUMERICAL TREATMENT OF NON-IDEAL MGD BASIC EQUATIONS. Friedel, H. (Innsbruck Univ. (Austria). Institut fuer Theoretische Physik). June 15, 1966. Contract AF 61(052)-675. 14p. CFSTI $3.00 cy, $0.65 mn.

The mathematical treatment of the MGD basic equations is rendered extremely difficult by dissipation terms. Such terms give rise to a parabolic degeneration of the otherwise hyperbolic equations and, consequently, exclude the application of the method of characteristics usually used in the nondissipative case. Summarizing the treatment of a previous report, and generalizing some of its results, a numerical method of solution for the parabolically degenerated one-dimensional MGD basic equations is given; it has been developed in analogy to the theory of characteristics. This method is advantageous insofar as it has, particularly for weak dissipation, stability properties similar to the method of characteristics (in the case of vanishing dissipation). This numerical method is used to investigate the unsteady development of the structure of a magnetically driven shock under the influence of finite electrical conductivity in MGD. The ($B \ll 1$)-approximation was used since it leads to a particularly simple and perspicuous form of the basic equations. (TAB)

23048 (AD-643788) PENETRATION OF THE ELECTROMAGNETIC FIELD IN MOVING CONDUCTORS. Levi, Enrico (Polytechnic Inst. of Brooklyn, N. Y. Microwave Research Inst.). Sept. 6, 1961. Contract AF 30(602)-2149. 5p. (PIBMRI-950-61). CFSTI $3.00 cy, $0.65 mn.

In general, it can be said that in a fully ionized gaseous plasma the conductivity is independent of the density and in a solid nonferromagnet material the permeability is essentially that of vacuum. As for the dielectric constant, it disappears from the equations once it is recognized that wave propagation phenomena do not play a significant role. In addition, the conductor is assumed to be incompressible and ideally cooled so that the pulse generation process is isothermal. The effects arising from mechanical and thermal stresses are therefore considered as small perturbations to be introduced once the body forces and the Joule losses in the conductor have been evaluated. (TAB)

23049 (D-1-82-0605) HYDROMAGNETIC SURFACE WAVES IN A CONDUCTING LIQUID SURROUNDED BY A COMPRESSIBLE GAS. Gerwin, Richard (Boeing Scientific Research Labs., Seattle, Wash. Plasma Physics Lab.). Feb. 1967. 23p.

Those surface waves are studied that can propagate along a plane interface separating a conducting (incompressible) liquid from a nonconducting, compressible gas, when there is a static magnetic field parallel to the interface. For any given direction of propagation (except exactly perpendicular to the magnetic lines), an effective critical field strength is found above which surface Alfvén waves cannot exist. Instead, at these strong magnetic fields, there are surface sound waves in the gas. The critical magnetic field at which the transition from Alfvén-type to sound-type surface waves takes place is practically independent of the gas density, depending essentially only on its temperature. (auth)

23050 (UCRL-4333(Rev.1)) LECTURES ON HYDRODYNAMICS AND SHOCK WAVES. Lelevier, Robert; Ragent, Boris (California Univ., Livermore. Lawrence Radiation Lab.). Sept. 17, 1965. Contract W-7405-eng-48. 65p. Dep. mn. CFSTI $3.00 cy, $0.65 mn.

An elementary treatment is presented of shock hydrodynamics in a convenient form. Following a brief formulation of the mathematical description of continuous flow, three main topics are discussed. These are the Hugoniot relations for shocks, the method of characteristics as applied to one-dimensional gases, and methods of integration using high-speed digital computers. (auth)

23051 THEOREMS OF EXISTENCE AND UNICITY FOR NONSTATIONARY FLOW WITH ZERO MAGNETIC REYNOLDS NUMBER. Sanchez-Palencia, Enrique (Facultе des Sciences, Paris. Univ., Madrid). Compt. Rend., Ser. A, 264: 363-6(Feb. 20, 1967). (In French).

A translation movement of a solid body in an incompressible and viscous fluid with a high electric conductivity in the presence of a magnetic field was considered. The existence of a weak solution of the problem in the case where the magnetic Reynolds number is zero is shown. If the flow is bidimensional, the solution is unique. (tr-auth)

23052 CONDUCTING JET IN A MOVING MEDIUM IN THE PRESENCE OF A TRANSVERSE MAGNETIC FIELD. Shcherbinin, E. V. (Inst. of Physics, Riga). Latv. PSR Zinat. Akad. Vestis, No. 5, 56-61(1966). (In Russian).

A solution is given for the distribution of the velocity and the induced magnetic fields in a jet flowing in the same direction as the moving medium. (auth)

23053 INFLUENCE OF FINITE ELECTRICAL CONDUCTIVITY ON THE DEVELOPMENT OF A MAGNETICALLY DRIVEN SHOCK IN MGD ($\beta \ll 1$)-APPROXIMATION. Friedel, Helmut (Univ., Innsbruck). Z. Angew. Math. Phys., 18: 85-92(1967).

A numerical method of solution for the parabolically degenerated one-dimensional MGD basic equations is given; it has been developed in analogy to the theory of characteristics. This method is advantageous insofar as it has—particularly for weak dissipation—similar stability properties as the method of characteristics (in the case of vanishing dissipation). Using this numerical method, the unsteady development of the structure of a magnetically driven shock under the influence of finite electrical conductivity is investigated in MGD-($\beta \ll 1$) approximation. The ($\beta \ll 1$) approximation was chosen since it leads to a particularly simple and perspicuous form of the basic equations. (W.D.M.)

23054 FLOW RATE MODIFICATION IN A HETEROGENEOUS MAGNETIC FIELD. Vatazhin, A. B. Prikl. Mat. Mekh., 31: 72-9(Jan.-Feb. 1967). (In Russian).

Effects of anisotropic electric conductivity and the end inhomogeneity of incompressible inviscid flow on the rate profile in inhomogeneous magnetic fields were investigated. (R.V.J.)

23055 MOTION OF A NON-UNIFORM HYDROMAGNETIC SHOCK WAVE. Gundersen, Roy M. (Univ. of Wisconsin, Milwaukee). Z. Angew. Math. Phys., 18: 116-19(1967).

Smith (Proc. Edin. Math. Soc., 13: 297-302(1962/63)) has shown that Weir's (Proc. Camb. Phil. Soc., 57: 890-4(1961)) family of exact solutions could be connected by a shock wave to a gas at rest in which the density was non-uniform. It is shown that similar conclusions hold in the magnetic case. The method of solution is inverse in that the shock path is determined by the use of the usual jump conditions; then, the nonuniform density distribution in front of the shock is obtained in parametric form in terms of the equation of the shock locus. (W.D.M.)

23056 MAGNETOHYDRODYNAMIC FREE CONVECTION IN A STRONG CROSS-FIELD. D'sa, Edward R. (Makerere University Coll., Kampala, Uganda, S. Africa). Z. Angew. Math. Phys., 18: 106-15(1967).

The situation studied is the steady MHD free convection flow up a heated vertical plate. The density variations due to temperature changes are assumed to be small so that they only need to be taken into account in the buoyancy term and all fluid properties are otherwise constant. The external magnetic field acts normal to the plane of the plate and the magnetic Reynolds number is small so that the induced field may be neglected. The electric field is zero and the solution is independent of the plate conductivity. (W.D.M.)

23057 STATISTICAL MECHANICAL BASIS OF MAGNETOHYDRODYNAMICS. Brittin, Wesley E.; Chappell, Willard R. (Univ. of Colorado, Boulder). pp 101-43 of Lectures in Theoretical Physics. Vol. VIII A. Brittin, Wesley E. (ed.). Boulder, Colo., University of Colorado Press, 1966.

A systematic account of the use of probability densities in the statistical treatment of electromagnetic fields is presented. Because of the complexity of the general theory, the statistical theory of the simple string is first described. The same methods are then applied to the classical electromagnetic field interacting with charged particles. A set of equations is derived, which, together with subsidiary conditions, can be used as the starting point to generalize the macroscopic equations of magnetohydrodynamics. (A.G.W.)

23058 MAGNETOHYDRODYNAMIC FLOW IN A RECTANGULAR DUCT WITH PERFECTLY CONDUCTING ELECTRODES. Chiang, Donald; Lundgren, Thomas (Univ. of Minnesota, Minneapolis). Z. Angew. Math. Phys., 18: 92-106(1967).

The flow of an incompressible, electrically conducting fluid through a rectangular duct with an external magnetic field applied transverse to the flow and parallel to two of the walls is considered. A large Hartmann number and boundary layer methods are used to cast the problem in the form of an integral equation. (W.D.M.)

23059 THE INFLUENCE OF THE HALL EFFECT ON THE PROPAGATION OF WEAK DISTURBANCES IN THE RELATIVISTIC MAGNETOHYDRODYNAMICS. Deutsch, R. V. (Polytechnic Inst., Iasi). Rev. Roum. Phys., 11: 917-24(1966).

The dispersion equation for monochromatic waves in the relativistic magnetohydrodynamics is deduced by neglecting the damping of magnetohydrodynamic waves and taking into account the Hall effect. The hodograph of the phase velocity is also studied and the appearance of an elliptic polarization of these waves is proved. The influence of the Hall effect on the Friedrichs diagrams is observed. Due to the Hall effect, in the case of Alfvèn waves, the Friedrichs diagram is no longer reduced to a single point and will present a closed curve intersecting the axis which is parallel to the magnetic line of force at two points: the first corresponding to the Alfvèn velocity and the second to the light velocity. It is also proved that owing to the Hall effect, when Alfvèn waves are propagating a periodic variation of the medium density will also appear. (auth)

23060 FLOW OF LIQUID IN A TUBE WITH GRID ELECTRODES IN A REGIME OF WEAK MAGNETOHYDRODYNAMIC INTERACTION. Bolislavskii, A. I.; Yantovskii, E. I. Zh. Prikl. Mekh. Tekh. Fiz., No. 5, 101-3(Sept.-Oct. 1966). (In Russian).

Stationary flow of incompressible and nonviscous fluid in a round nonconducting tube is considered. The flow is weakly interacting with the grid electrodes in the tube. The hydrodynamic equations describing this system are written out for the case of constant potential on the electrodes. These equations are recast into dimensionless form and simplified by assuming the dynamic pressure to be much greater than the magnetic pressure. The resulting equation for the magnetic field is of the second order and its solution is written out in the form of an infinite series. (ATD)

23061 SIMPLE SOLUTION FOR THE DECLINE OF THE HOMOGENEOUS TURBULENCE IN THE PRESENCE OF A UNIFORM MAGNETIC FIELD WHEN THE MAGNETIC REYNOLDS NUMBER IS SMALL. Moreau, Rene (Univ., Grenoble, France). Compt. Rend., Ser. A, 264: 75-81(Jan. 9, 1967). (In French).

The energy spectra, the energy transfer spectra, and the spectra characteristic of the dissipation by Joule effect are introduced. An affine solution for the evolution in time for these spectra is investigated and analyzed. The degree of anisotropy and electric energy of a turbulence axisymmetric to the isotropic tensor structure is calculated, within the framework of this affine solution. (tr-auth).

23062 DEVELOPMENT OF HARTMANN'S FLOW TEMPERATURE FIELD. Blum, E. Ya.; Tsepure, I. Ya. (Inst. of Physics and Power Engineering, Riga). Latv. PSR Zinat. Akad. Vestis, No. 5, 48-55(1966). (InRussian).

The results of a numerical calculation of the temperature profile development of a one-dimensional stabilized MHD flow in boundary conditions of the first order (T_w = const) are presented. The viscous and the Joule dissipation were taken into account. The role of wall conductivity, as well as the influence of crossed electric and magnetic fields on the heat transfer, were investigated. A formula for determining the total heat transfer change in a transverse magnetic field is suggested (Ec $\ll$ 1). (auth)

23063 TEORIA MAGNETOHIDRODINAMICA IN FIZICA PLASMEI. (Theory of Magnetohydrodynamics and Plasma Physics). Deutsch, R. V. Bucharest, Editura Academiei Republicii Socialiste Romania, 1966. 546p.

The flow of plasma in a magnetic field represents one of the chief topics of the book which attempts to indicate the range of applicability of magnetohydrodynamics. The theorem of "freezing" of the magnetic field within the plasma permits reformulating general theorems, such as Thomson's theorem, the Lagrange–Cauchy integral and Bernoulli's equation, in order to examine the flow of plasma in a direction perpendicular to the lines of force and to derive the concept of a model based on elastic lines of force. The problems of magnetohydrodynamic equilibrium, propagation of magnetohydrodynamic waves and plasma discontinuities are studied, together with the problems involved in the steady magnetohydrodynamic motion and the various types of instabilities. Consideration is also given to the turbulent magnetohydrodynamic flow, deriving the spectral functions for the various limiting cases. Finally, the most important results of the relativistic magnetohydrodynamics are presented including a balanced description of the whole field. (TTT)

23064 THE PROPERTIES OF GASES AND LIQUIDS. Their Estimation and Correlation. Second Edition. Reid, Robert C.; Sherwood, Thomas K. McGraw-Hill Chemical Engineering Series. New York, McGraw-Hill Book Co., 1966. 664p. $27.50.

Methods for estimating and correlating the more important physical and thermodynamic properties of gases and liquids are reviewed and evaluated. Comparisons of experimental and estimated values of these properties indicate the degree of reliability of the methods discussed. Recommendations are made as to the best methods of estimating each property and of extrapolating and in-

terpolating available data. The chapters cover such subjects as: critical constants and other characteristic parameters for pure materials; pressure–volume–temperature relationships of pure gases and liquids; vapor pressures and latent heats of vaporization of pure compounds; ideal-gas heat capacities, heats and free energies of formation; viscosity; thermal conductivity; and diffusion coefficients. (J.H.M.)

Geophysics

Refer also to abstracts 22077 and 22218.

23065 (AD-640978) EFFECT OF THE FINITE WANTED PULSE WIDTH ON THE RADIO WAVE INTERACTION EXPERIMENTS. Pinkerton, Thomas D. (Pennsylvania State Univ., University Park. Ionosphere Research Lab.). June 15, 1966. Contract Nonr-656(35). 96p. CFSTI $3.00 cy, $0.65 mn.

Wave interaction equations are extended to take into account the finite width of the wanted pulse. The effect of the wanted pulse width upon the wave interaction experiment is demonstrated through the use of this new equation by showing the effect that it has on the interaction coefficient height profile and by showing its importance in electron density synthesis. The significance of the effect of underlying ionization is demonstrated by evaluating the error that occurs in the synthesized electron density profile when it is neglected. It is also shown that the region of dominant heating plays an important role in determining whether underlying ionization can be neglected in synthesizing the electron density. A technique of obtaining the whole interaction coefficient height profile by making a simultaneous measurement of the fundamental frequency component of the repetitive disturbing pulses and a number of its harmonics is presented and a feasibility study of this technique is made. It is found that this technique can eliminate the long sweep time presently needed to make interaction measurements and could possibly allow data to be reasonably extrapolated to include below its present minimum height. (auth)

23066 (AD-641175) MOTION-INDUCED DISTURBANCES OF IONIZED GASES. Final Report, October 1, 1964–July 1, 1966. Raemer, Harold R. (Northeastern Univ., Boston, Mass.). Contract AF19(628)-4325. 217p. (AFCRL-66-636). CFSTI $3.00 cy, $0.65 mn.

The research is ultimately directed toward an improved understanding of wave disturbances in the ionosphere. Particular emphasis is placed on construction of very general mathematical models for analysis of ionospheric wave disturbances. The model discussed is one in which the ionosphere is described as a linearized electron–ion–neutral gas that is vertically nonuniform in the static parameters, e.g., pressures, densities, collision frequencies, etc., and which includes the effects of the earth's magnetic field. Analytical and numerical methods of solving the system of coupled differential equations arising from the formulation are discussed. A computer program for solving these equations is described. Also discussed are degenerate subcases that are more easily solved and are useful in interpreting the more general results. Generalizations of the model to include some of the effects of viscosity and heat conduction are also treated. (auth)

23067 (AD-641204) DIFFUSION MODEL OF LOW-ENERGY CHARGED PARTICLES ALONG OPEN FIELD LINES. Scientific Report No. 277. Grebowsky, Joseph M. (Pennsylvania State Univ., University Park. Ionosphere Research Lab.). July 30, 1966. Contract AF19(628)-4014. 40p. (AFCRL-66-671). CFSTI.

Just after dayside connection of the field lines, there is a discontinuity in charged particle densities which yields a negative potential on the interplanetary side. The electrons travel a distance comparable to the size of the magnetosphere in a few minutes—a time much smaller than the period of the field line circulation. Thus the electrons can be treated independently of time. However, a time dependent study of the proton motions must be considered. Using a step function for the proton distribution of velocities, the magnitude of the electric field potential determined from quasineutrality is of the order of volts. The resulting potential profile implies that some electrons will be trapped between the low altitude magnetic mirror and an electric potential wall as the field line travels toward the nightside. It also appears that spikes in electron density propagate away from the initial discontinuity. (auth)

23068 (D-1-82-0589) RESONANT PARTICLE ENERGY TRANSFER TO MAGNETIC PERTURBATIONS WITH APPLICATION TO THE GEOMAGNETIC TAIL. Hoh, F. C.; Bers, A. (Boeing Scientific Research Labs., Seattle, Wash. Plasma Physics Lab.). Dec. 1966. 9p.

It is shown how resonant particles can give up their kinetic energy to induced electric fields and hence cause amplification of the perturbed magnetic field energy. This is a simple physical picture of the instability of the sheet pinch. It reveals the nature of the instability and gives some insight into its degree of violence. (J.H.M.)

23069 (LA-DC-7524) SHOCK-WAVE COMPRESSION OF IRON–NICKEL ALLOYS AND THE EARTH'S CORE. McQueen, R. G.; Marsh, S. P. (Los Alamos Scientific Lab., N. Mex.). [1965]. Contract W-7405-eng-36. 23p. Dep. mn. CFSTI $3.00 cy, $0.65 mn.

Shock-wave compressions were measured on Fe and on Fe alloyed with 10, 18, and 26% Ni to 1.8 Mbars. It was found that at a given pressure the density increases in a reasonable manner with increasing Ni content. This refutes the work and conclusions of Takahashi and Bassett who report that the Fe–10% Ni alloy will be approximately 10% lighter than pure Fe under conditions existing in the core. The shock-wave data are compared with previously proposed pressure–density distributions of the core. It appears that pure Fe is about 8% more dense than current models, with the Fe–Ni alloys showing even poorer agreement. (auth)

23070 (LA-DC-7554) DIRECTIONAL AND SPATIAL DISTRIBUTIONS OF THE ELECTRON POPULATION IN THE NEUTRAL SHEET. Bame, S. J.; Asbridge, J. R.; Felthauser, H. E.; Olson, R. A.; Strong, I. B. (Los Alamos Scientific Lab., N. Mex.). [1965]. Contract W-7405-eng-36. 15p. Dep. mn. CFSTI $3.00 cy, $0.65 mn.

According to recent magnetospheric models, the magnetic field lines from regions near the neutral sheet in the earth's magnetic tail intersect the earth at latitudes above the trapping zone on the night side of the earth. Electron fluxes observed from low altitude satellites at high latitudes on the night side are thought to be related to fluxes in the tail and to the existence of strong acceleration mechanisms there. Launch 2 Vela measurements have shown that within the neutral sheet the electron population is often energized over periods of a few minutes, with a slower decay of the average energy over periods of a few hours. These regions of energized electrons may be sources of the electrons observed near the earth at high latitudes. Further characteristics of low-energy electrons (0.35 to 20 keV) and energetic electrons (above 45 keV), which bear on the possible connection between the neutral sheet and the high-latitude zones, are reported. (W.D.M.)

23071 (N-67-12929) INTERPRETATION OF MAGNETIC MEASUREMENTS ON PIONEER-1 AND ITS GEOPHYSICAL CONSEQUENCES. Gintsburg, M. A. Translated from Kosm. Issled., 4: 296-301(1966). 6p. (NASA-CR-80165). CFSTI $3.00 cy, $0.65 mn.

A collisionless shock wave near earth is possible only because it is oblique. An oblique shock wave consists of oblique solitary pulses. The properties of these pulses (amplitude, polarization) as functions of velocity and angle 0 are analyzed. The hypothesis is developed that the acceleration of soft electrons ($E \sim 1$ keV, third radiation belt, aurora electrons, electrons ionizing the night ionosphere), and also of electrons with energies $E \gtrsim 40$ keV (outer radiation belt) precisely takes place in oblique pulses. Experimental corroborations of this hypothesis are brought up together with morphological consequences. (auth)

23072 (N-67-15150) RESPONSE OF IONOSPHERIC ELECTRON DENSITY TO A CHANGE OF ELECTRON TEMPERATURE. Pound, T. R.; Yeh, K. C. (Illinois Univ., Urbana. Electrical Engineering Research Lab.). Dec. 1966. 139p. (NASA-CR-81079). CFSTI $3.00 cy, $0.65 mn.

Using a spatial model of the ionosphere in which the F2 region ionization loss rate is assumed to be much slower than the rate of transport of ionization to the lossy lower region of the ionosphere, several aspects of F2 region behavior for near sunspot minimum conditions were investigated. With a temporal model in which the transition between temporal phases is assumed to be a step function, the variation of the electron number density and content in the daytime and nighttime ionosphere and the transition between these temporal phases, sunset and sunrise, are shown to possess an extremely high degree of consistency and to show close relationships. (auth)

23073 (NASA-SP-3024(Vol.3)) MODELS OF THE TRAPPED RADIATION ENVIRONMENT. VOLUME III. ELECTRONS AT SYNCHRONOUS ALTITUDES. Vette, James I.; Lucero, Antonio B.; Wright, Jon A. (Aerospace Corp., El Segundo, Calif.). 1967. 111p. CFSTI $3.00 cy, $0.65 mn.

The work is confined to the construction and discussion of the trapped electron environment at synchronous altitudes. Data were processed from Explorer 6, Explorer 12, Explorer 14, Imp A, OGO A, and ERS-17 to obtain a detailed sampling of various detectors covering the energy range between 40 keV and 2 MeV and the time range from near solar maximum through solar minimum. The specific data used in the environment are tabulated. (J.H.M.)

23074 (NP-16648) ANALYSIS OF LOW LATITUDE D AND E REGION DATA. Semi-Annual Technical Report No. 2, May 15,

1966–November 15, 1966. Sears, Robert D. (IIT Research Inst., Chicago, Ill.). Jan. 1967. Contract N00014-66-C0030. 50p. (T-6142-5).

A technique for determining the electron density profile in the E region from group path, phase path, amplitude and true height analysis data is described. A selected data period, 1600 to 2100 GMT on October 15 to 19, is summarized in the detailed reduction and analysis of the individual data obtained from the different measurement techniques. One period of detailed electron density profile computation is presented. The period 1700 to 1800 GMT in October 1962, also included a moderately intense solar flare so that the excess ionization caused by the flare in the lower ionosphere may be observed. The true height analyses which are developed are extensions of the true height analyses of the F region and serve to extend conventional true height analysis to lower altitudes or lower electron densities than possible from the conventional analyses alone. The data were obtained utilizing ionosondes, a three frequency HF propagation measurement of both phase and amplitude and riometer measurements of cosmic noise absorption. To develop the profiles, the group height records from ionograms and phase height measurements from the HF experiment were used. (auth)

23075 (NP-16651) JONOSFARSTORNINGAR OBSERVERADE I SAMBAND MED KARNLADDNINGSPROV VID NOVAJA SEMLJA DEN 23 OCH 30 OKTOBER 1961. (Ionospheric Disturbances Observed in Connection with the Nuclear Test at Novaya Zemlya on 23 and 30 October 1961). Stoffregen, W. (Forsvarets Forskningsanstalt, Stockholm (Sweden)). May 1962. 20p. (In Swedish). Dep. mn.

Continuous records of the ionosphere anomalies were made at Uppsala and Lycksele during the fall of 1961. Strong disturbances were found after the tests on 23 and 30 October; the disturbing effects were large in the F layer (250 km), but some evidence of absorption is found also in the lower ionosphere at Lycksele and Uppsala. The travelling disturbance appeared on back-scatter records as a V-shaped pattern. The variation of the F-layer disturbance with distance and corresponding velocities for different waves is diagrammed; the disturbance at 3000 km was violent compared with the disturbance at Swedish stations. The disturbance is explained as a pressure wave; at the F region the wave travels without much loss of energy at about 600 m/sec, but at 80 km with attenuation over northern Sweden at 300 m/sec. Measurements at Lycksele showed that the Li emission was still below the low limit of the spectrograph SP3, or less than 1% of the emission of natural Na at 80 km. (BBB)

23076 (NP-16684) DETERMINATION OF D-REGION TIME CONSTANTS FOR ELECTRON COOLING AND ELECTRON DENSITY PROFILES FROM PHASE OR AMPLITUDE WAVE INTERACTION MEASUREMENTS. Scientific Report No. 288. Spielman, B. E. (Pennsylvania State Univ., University Park. Ionosphere Research Lab.). Jan. 30, 1967. Contract NOnr-656(35). 102p.

A technique is developed for determining electron density profiles in the D region from measurements of either phase or amplitude wave interaction. The method accounts for the effects of underlying ionization and a wanted pulse of finite width, while assumptions inherent in the methods of previous workers are relaxed. Two techniques are developed for the determination of D-region time constants for cooling from either phase or amplitude wave interaction measurements. Neither technique necessitates employing a gyro-wave disturbing signal. In one method an iterative partial sum per cent error procedure is used to find the best exponential profile for the interaction measurements. This technique accounts for the effect of underlying ionization. In the other method a value of the time constant is determined for the region of dominant heating from the slope of the interaction curve at upper heights. Both of these techniques have been extended to include the effects of a wanted pulse of finite width. (auth)

23077 (RM-5296-PR) ECONOMICAL METHODS FOR CALCULATING LF AND VLF IONOSPHERIC ATTENUATION BASED ON WAVE THEORY. Crain, C. M.; Booker, H. G. (RAND Corp., Santa Monica, Calif.). Mar. 1967. 22p.

A modified version of the method previously presented by the authors is applied to estimate the attenuation on reflection from an ionosphere having a conductivity profile that is basically exponential in character. Results are compared with similar calculations by Berry using a staircase fit to the profile with 1-km steps. It is concluded that simple procedures such as originally described by Crain and Booker, with modifications discussed by Booker and Crain, can be used to obtain economically and reliably the reflection loss for lf and vlf waves obliquely reflected from permittivity profiles which are basically exponential in character, as are most profiles encountered in a nuclear environment. (auth)

23078 (JPRS-40082) OUTER IONOSPHERE AND ITS TRANSITION TO THE INTERPLANETARY MEDIUM. Al'pert, Ya. L. Translated from Usp. Fiz. Nauk, 90: 405-33(1966). 42p. (TT-67-30729). CFSTI $3.00 cy, $0.65 mn.

Information is presented on the structure of the ionosphere to its upper boundary and the charged particles that are swept out from the higher regions of the magnetosphere. Discussions are included on the density of charged particles as a function of height, temperature of the outer ionosphere, inhomogeneous formations, and ionization balance. Methods are also discussed for investigating the outer ionosphere. (J.H.M.)

23079 (NASA-TT-F-390) METHODS OF INVESTIGATING THE ATMOSPHERE WITH ROCKETS AND SATELLITES. Kmito, A. A. Translated from pp 1-36 of Metody Issledovaniya Atmosfery s Ispol'zovaniyem Raket i Sputnikov, Gidrometeorologicheskoye Izdatel'stvo, Leningrad, 1966. 351p. CFSTI $3.00 cy, $0.65 mn.

Numerous methods of investigating the upper atmosphere by scientific rockets and satellites, including ionosphere sounding probes, meteorological rockets, orbiting geophysical and solar observatories of the USSR and USA are described in detail, and underlying physical principles are reviewed, with wiring diagrams and tabulated data on the instrumentation capsules used. Photographic, telemetry, and television-onboard-and ground equipment is discussed, with specific reference to achievements on various unmanned and manned satellite and space probe series. (auth)

23080 TERRESTRIAL XENON ANOMALY AND EXPLOSION OF OUR GALAXY. Takagi, Jinzaburo; Sakamoto, Koh; Tanaka, Shigeo (Tokyo Univ.). J. Geophys. Res., 72: 2267-70(Apr. 15, 1967).

The $^{129}Xe-^{131}Xe$ excess in geologically old tellurium ore is an important problem, as yet unresolved. An attempt is made to interpret the anomaly pattern of xenon isotopes by muon interactions on tellurium ore and its environmental rocks. The source of high muon flux necessary to explain the large excess amounts of the Xe isotopes is discussed in terms of the explosion of the galaxy in the past. (W.D.M.)

23081 ORIGIN OF THE PULSATIONS OF THE EARTH ELECTROMAGNETIC FIELD. Vero, Jozsef. Geofiz. Kozlem., 16: 113-20(1967). (In Hungarian).

The individual types of pulsation of the earth's electromagnetic field, especially the pc 3 and pt pulsations, are explained. Although these differ from each other, they possess certain characteristic similarities which have lead some authors to the assumption that in the morning and at evening a gradual transition occurs between the day and night types. There are two viewpoints on this transition: according to the first the pc pulsations should be formed from the approximately 60-sec pt(pi 2) and according to the second from the approximately 8-sec short night variation (pi 1) these hypotheses of the transition which play a significant role in the clarification of the origin mechanisms of the pulsation are reviewed. Both types often follow each other suddenly. The time point of the transition has no direct yearly pattern, but is determined by the magnetic activity. On very quiet days the night activity is absent and on very active days it appears during the entire day. The consequences of these data with respect to the state of the exosphere are shown. (tr-auth)

23082 APPEARANCE OF "IRREGULAR PULSATIONS OF DECREASING PERIOD" DURING THE DISPLACEMENTS OF THE EXTERNAL BOUNDARY OF THE VAN ALLEN ZONES. Lacourly, Sylvaine; Gendrin, Roger (CNET, Issy-les-Moulineaux, France). Comp. Rend., Ser. B, 264: 658-61(Feb. 20, 1967). (In French).

It is shown that the irregular pulsations with decreasing period appear when the exterior boundary of the Van Allen zone approach the earth, the drawing nearer being bound to the release of the lines of force of the nocturnal side, at the time of magnetic storms. (tr-auth)

23083 METHOD OF SOLVING THE GENERAL BOUNDARY VALUE PROBLEM OF THE PROPAGATION OF LONG AND SUPER LONG RADIO WAVES AROUND THE EARTH. Krasnushkin, P. E. (Mathematics Inst., Moscow). Dokl. Akad. Nauk SSSR, 171: 61-4(Nov. 1, 1966). (In Russian).

The problem solved is that of finding the amplitudes of the electric and the magnetic fields produced a Hertz dipole in an unbounded medium described by Maxwell's equations (in spherical coordinates), having a variable dielectric tensor, and divided into three regions—the earth, the atmosphere, and the ionosphere. The problems formulated in an approximate differential-operator formulation and is solved by the method of coupled lines, described earlier by the author. The solution is obtained in the form of a sum of modulated normal modes. A method of determining the wave numbers of the modes, suitable for computer solution, is described.

The final approximate solution for the boundary value problem is obtained from the calculated wave numbers and radiation admittances of the different regions. (ATD)

23084 VIOLATION OF RECIPROCITY PRINCIPLE IN DAYTIME PROPAGATION OF SUPERLONG RADIO WAVES AROUND THE EARTH. Krasnushkin, P. E.; Baibulatov, R. B. (Mathematics Inst., Moscow). Dokl. Akad. Nauk SSSR, 171: 340-3 (Nov. 11, 1966). (In Russian).

A phenomenon is explained, which is called the valve effect, and which consists in the fact that the attenuation of superlong waves on paths from east to west is larger than in the opposite direction, especially during daytime propagation near the geomagnetic equator. Although this phenomenon has not been taken into account in the existing waveguide theory of superlong waves, it is shown that allowance for the valve effect can be made by using a method developed earlier (Dokl. Akad. Nauk SSR., 171: 61(1966)). This method is used to calculate the impedances contained in the equation for the wave numbers of the normal waves, with account taken not only of the vertical component of the earth's magnetic field, but also of the horizontal components along and across the propagation path. It is shown that the parameters of TH waves for arbitrary daytime paths on earth can be calculated with sufficient accuracy by means of the derived impedance equations. The damping coefficients and the differences of the angular wave numbers are electronically computed for TH_1 waves with two types of profiles (medium latitudes in the summer and equatorial zone). In medium latitudes the valve effect is attenuated by the C region of the ionosphere, which is produced by cosmic rays, and by the decrease in the latitudinal component of the magnetic field. The absence of the C region in the equatorial zone is also confirmed by the present results. (ATD)

23085 NOCTURNAL ELECTRICAL CONDUCTIVITY OF THE EQUATORIAL IONOSPHERE. Kamiyama, Hiroshi (Tohoku Univ., Sendai). Rep. Ionosphere Space Res. Jap., 19: 359-63 (1965).

In attempts to determine why nocturnal variations in the geomagnetic field do not show any significant anomaly at the equator, characteristics of the ionospheric conductivity at and near the dip-equator were studied, with attention to the nocturnal condition. The height of the E layer is known to be generally higher during the night than during the daytime. Therefore, the electron density in the region (near 100 km) where the tensor component of ionospheric conductivity (σ_{yy}) would be enhanced at the equator may be considerably lower during the night. Hence, the contribution from the enhanced conductive region to the integration with respect to height may be much smaller during the night than during the daytime. This may be an additional reason why the equatorial intensification of geomagnetic variations is not so marked during the night. On the basis of a model of the ionosphere, the equatorial electrojet during the daytime was shown to be located below the uniform sheet which may not vary much with latitude, the electrojet being near the 100-km level, and the uniform sheet in the region between 120 and 150 km. The half-width of the jet is about 3° latitude. In the nighttime condition, however, only a slightly enhanced region can be seen at the equator. The latitudinal variation of the integration of σ_{yy} with respect to height up to 200 km is shown, both for day and night conditions. The factor of the equatorial enhancement is about 13 in daytime, but only about 2 at night. (BBB)

23086 A REMARK ON THE EQUATORIAL ELECTROJET. Kamiyama, Hiroshi (Tohoku Univ., Sendai). Sci. Rep. Tohoku Univ., Fifth Ser., 17: 32-42(Aug. 1965).

An explanation was sought for why nocturnal variations in the magnetic field do not show any significant anomaly at the equator. Some characteristics of the ionospheric conductivity were studied, with special reference to conditions during the night. On the basis of model of the ionosphere, a description is also given of the profile of the equatorial electrojet. In the dynamo region, the Pedersen conductivity is essentially due to ions. The negative ion concentration becomes comparable with electron density during the night especially for low electron density because of the absence of photodissociation. Therefore, the ratio of the Hall conductivity to the Pedersen conductivity is reduced during the night, because the Hall conductivity is proportional to electron density. This leads to a much less pronounced anomaly at the dip-equator during the night than during the daytime. With a possible model of the ionosphere, the factor of the equatorial enhancement was found to be about 13 during the daytime and only about 2 during the night. The equatorial electrojet during the daytime is described as being located below a uniform sheet which may not vary much with latitude, the electrojet being near the 100-km level and a uniform sheet between 120 and 150 km. Under suitable conditions of electron distribution, 2 sheets of electric current could be expected, the lower being between 100 and 110 km, and the upper in the region above 120 km. The half-width of the equatorial electrojet is about 3° of latitude. (BBB)

23087 ASSOCIATION OF PHASE CHANGES OF IONOSPHERE-PROPAGATING RADIO WAVES AND GEOMAGNETIC VARIATIONS. Lewis, T. J. (Univ. of British Columbia, Vancouver). Can. J. Phys., 45: 1549-63(Apr. 1967).

Classification of Doppler frequency changes of ionosphere-propagating radio waves has been made with special emphasis on their possible relationships with simultaneous geomagnetic variations. The Doppler frequency changes are suitably divided into two classes: rapid variations and slow changes, according to whether or not the time scale of a change is shorter than about 4 minutes. The overall coincidence between geomagnetic variations and Doppler frequency changes is poor. However, it is found that rapid geomagnetic variations such as sudden impulses and pi 2 micropulsations accompany a Doppler frequency change with a high degree of probability. The correspondence between the two is activity-wise in most cases. Peak-to-peak correspondence has been observed, however, in some cases, when the Doppler frequency changes amount to a few tenths of a c.p.s. for magnetic variations of unit strength (1γ in the south–north component). The coincidence is also very good for sudden commencements of magnetic storms. The ratio of the main positive frequency change to the magnetic-field variation in the south–north component is about one order smaller than that for the above-mentioned group. The correspondence is, in most cases, indefinite for geomagnetic bays. When a clear coincidence is seen, the ratio of the change of frequency to magnetic variation is of the order of a few hundredths of a c.p.s. per γ. (auth)

23088 WAVE PROPAGATION IN EARTH-IONOSPHERE WAVEGUIDE. Lee, S. W. (Univ. of Illinois, Urbana). Appl. Sci. Res., 17: 115-32(1967).

Wave propagation in a stratified medium which consists of earth, atmosphere, and ionosphere, is studied. The ionosphere is described by a compressible plasma model where the earth magnetic field is neglected. The earth is considered as a highly conducting medium. The modal solutions due to the excitation of a vertical dipole were obtained, where characteristic waves are analytically discussed and numerically determined. (auth)

23089 GEOMAGNETIC EFFECTS ASSOCIATED WITH ACTIVE SOLAR REGIONS. Bhargava, B. N. (Colaba Observatory, Bombay). Curr. Sci. (India), 36: 85-7(Feb. 20, 1967).

The origin on the sun and the nature of several types of particles responsible for terrestrial magnetic and related effects are tabulated. Discussions are included on steady solar wind, flare-associated activity, ultraviolet and x-ray emission and simultaneous effects, and solar activity and recurrent magnetic storms. (J.H.M.)

23090 THE FREQUENCY SPECTRUM OF Pi 2 MICROPULSATION ACTIVITY AND ITS RELATIONSHIP TO PLANETARY MAGNETIC ACTIVITY. Rostoker, Gordon (Univ. of British Columbia, Vancouver). J. Geophys. Res., 72: 2032-9(Apr. 1, 1967).

An analysis is made of the relationship between the occurrence and characteristics of Pi 2's and planetary magnetic activity. Results indicate that a Pi 2 event may consist of anywhere from one to several frequency components and that the number of frequency components in an event is directly proportional to the strength of the planetary magnetic activity. It is found that the minimum frequency in a Pi 2 event decreases with increasing K_p as does the dominant frequency in an event obtained from visual analysis of chart recordings. It is suggested that Pi 2's originate as eigenoscillations on lines of force whose feet penetrate the auroral zone of a given event. (J.H.M.)

23091 AN OBSERVATION OF TRANSIENT VARIATIONS IN THE MAGNETOSPHERIC BOUNDARY POSITION. Freeman, J. W. Jr. (Rice Univ., Houston, Tex.); Kavanagh, L. D. Jr.; Cahill, L. J. Jr. J. Geophys. Res., 72: 2040-4(Apr. 1, 1967).

Data indicating the existence of long-period large-amplitude variations in the radial positions of the magnetopause on the sunlit side of the earth are presented. (auth)

23092 FINE STRUCTURE OF THE IONOSPHERE. D'Angelo, N.; Michelsen, P. (Atomic Energy Commission Research Establishment, Risoe, Denmark). J. Geophys. Res., 72: 2045-7 (Apr. 1, 1967).

The excitation of ion–acoustic waves by vertical gradients of density in the ionosphere is considered. The conclusion is reached that the fine structure of the ionosphere is probably affected by the resulting instability. An examination is made of the stability of the ionosphere against growth of low-frequency quasi-electrostatic waves, taking into account the compressibility of the plasma. (J.H.M.)

23093 SPORADIC-E IONIZATION AND ANOMALOUS INCREASE IN THE RATE OF RADAR METEOR COUNTS DURING 1963. Kotadia, K. M.; Jani, K. G. (Gujarat Univ., India). J. Atmos. Terrest. Phys., 29: 221-3(Feb. 1967).

Ionospheric data of some middle-latitude European stations do not indicate any significant change in the occurrences of sporadic-E(E_s) layers capable of reflecting vertically incident radio waves of frequencies greater than 3 Mc during 1963, when radar meteor counts showed an anomalously large increase. Instead, the low type of E_s was found less frequent during this period of large meteor incidence. (UK)

23094 THE THEORY OF THE ELECTRODE EFFECT. IV. VARIATION OF IONIZATION WITH HEIGHT. Chalmers, J. A. (Univ. of Durham, Eng.). J. Atmos. Terrest. Phys., 29: 217-19 (Feb. 1967).

In contrast to previous work (Chalmers, 1966) on the electrode effect, it is no longer assumed that ionization is independent of height. The result of a particular numerical assumption brings the ratio of potential gradients at the ground and at a distance closer to the observed value (near to unity), but does not give a complete explanation. (UK)

23095 AN ECLIPSE IN THE EQUATORIAL F-REGION. Olatunji, E. O. (Univ. of Lagos, Nigeria). J. Atmos. Terrest. Phys., 29: 267-75(Mar. 1967).

A study of the observed changes in the F layer during an annular eclipse of the sun at an equatorial station is presented. Values of the effective electron loss coefficients α and β are found, and some properties of these parameters are deduced. Changes of layer structure during the formation of an F1½ layer are shown. A measurement of the total columnar electron content during the eclipse demonstrates a pronounced eclipse effect in the topside ionosphere. (auth)

23096 POWER SPECTRA OF GEOMAGNETIC MICROPULSATIONS. Fooks, G. F.; Morgan, D. P. (Radio and Space Research Station, Ditton Park, Eng.). J. Atmos. Terrest. Phys., 29: 201-6(Feb. 1967).

The results of a visual frequency analysis of geomagnetic micropulsation records are compared with computed power spectra for four separate samples of data. The comparison shows that apparently dominant components in the record are associated with regions of the spectrum containing significantly greater amounts of power than neighboring regions, and so confirms the validity of the visual analysis. A somewhat special interpretation of the spectrum is necessary if the data are non-stationary statistically. (UK)

23097 TOTAL COLUMNAR ELECTRON CONTENT OF THE EQUATORIAL IONOSPHERE. Olatunji, E. O. (Univ. of Lagos, Nigeria). J. Atmos. Terrest. Phys., 29: 277-85(Mar. 1967).

The Faraday rotation technique is applied to study the features of the variations of the total columnar electron content at an equatorial station. Absence of a noon "bite-out" and the occurrence of a maximum near 1430 L.M.T. are some of the regular characteristics of the diurnal variation. Seasonal variations of ionization density in low-latitude stations are considered, and it is suggested that distance from the magnetic equator determines whether or not a low-latitude station will exhibit a seasonal anomaly. The diurnal development of the equatorial anomaly in the total columnar ionization is presented in evidence. An all-season asymmetry in the equatorial anomaly is indicated, and problems relating to evidence are outlined. (auth)

23098 ECLIPSE EFFECTS IN THE EQUATORIAL F-REGION. Skinner, N. J. (Ahmadu Bello Univ., Zaria, Nigeria). J. Atmos. Terrest. Phys., 29: 287-95(Mar. 1967).

Ionograms taken at Maiduguri, Nigeria, during the total solar eclipse of 2nd October, 1959, were analyzed to determine the photochemical rates in the F region. It is found that the variations of electron density at fixed altitudes are consistent with a "linear" loss coefficient β which varies with altitude as $\beta(h) = 2.45 \cdot 10^{-4} \exp[-(h-300)/84]$ sec^{-1} and an electron production rate q given by $q(h) = 330 \exp[-(h-300)/109]$ cm^{-3} sec^{-1}. These values of q and β are shown to be consistent with measurements of other workers when allowance is made for temperature variations during the solar cycle. A transition level between a quadratic and linear loss rate is found to occur at about 300 km. (auth)

23099 EAST-WEST MOTION OF AURORAE AS OBSERVED AT MOSCOW, IDAHO. Wilkins, L. H.; Assendrup, J. D.; Kim, J. S. (Univ. of Idaho, Moscow). J. Atmos. Terrest. Phys., 29: 311-16(Mar. 1967).

E–W motions of aurorae were studied at Moscow, Idaho, from January 17 to April 1, 1966, inclusive. The experimental equipment consisted of an I.G.Y. pulse-type auroral radar and two receiving antennae, each consisting of a vertical dipole in a 90° corner reflector. The transmitting antenna was a Telrex vertically polarized Yagi. A total of 284 radar echoes was received. Of that number it was possible to assign directions and speeds to 47 events. Another 63 echoes were stationary. The remaining 174 echoes were assigned a speed, but no direction. The E–W velocity characteristics of the aurorae under observation were as follows: (a) The average radial velocity of eastward-moving aurorae was 414 m/sec. Westward-moving structures had an average velocity of 502 m/sec. (b) A reversal in the direction of motion was found to occur at 2.00 a.m. P.S.T. Approximately 83% of the westerly auroral movements occurred before 2.00 a.m., and 83% of the eastward-directed motions occurred after that hour. Stationary echoes occurred at any time of the day. (c) The maximum hourly average speed of movements directed westward was 1210 m/sec and occurred between 11.00 p.m. and local midnight. The maximum value of movements directed eastward was 685 m/sec and occurred between 6.00 and 7.00 a.m. Hourly average speeds were significantly lower near the reversal hour. (auth)

23100 CHEMILUMINESCENT RADIATION FROM NITROGEN DIOXIDE DURING PCA EVENTS. Brown, R. R. (Univ. of California, Berkeley). J. Atmos. Terrest. Phys., 29: 317-20(Mar. 1967).

The chemiluminescent radiation from the interaction of nitric oxide and atmospheric ozone was evaluated for PCA conditions. The integrated emission rate obtained was small in comparison with radiation from the nightglow. (auth)

23101 SEASONAL VARIATIONS IN IONOSPHERIC TOTAL ELECTRON CONTENT. Yuen, P. C.; Roelofs, T. H. (Univ. of Hawaii, Honolulu). J. Atmos. Terrest. Phys., 29: 321-6(Mar. 1967).

Total ionospheric electron content was measured continuously since September, 1964, by observing the Faraday rotation of a linearly polarized wave received from the geostationary satellite Syncom III. Results of one year's observation (20°N) are presented in the form of monthly mean curves. The seasonal trend observed is that the largest diurnal peaks in daytime content tend to occur during the equinoxes and the smallest diurnal peaks during the solstices. The winter nighttime content remains nearly constant at about 0.3×10^{17} electrons/m^2. During the summer months, however, the nighttime content is about twice that of winter nights, and the decay rate is greater. Although daytime variations in electron content resemble those of N_{peak}, significant differences are observed. These are illustrated by curves of slab thickness vs. time. In general, the slab thickness curves exhibit strong seasonal dependence. The late afternoon values, however, are nearly the same throughout the year. In the winter, large pre-dawn and post-sunset peaks occur in the slab thickness curves. In the summer months a mid-morning peak is observed. (auth)

23102 SPORADIC E IN MIDDLE LATITUDES. Whitehead, J. D. (Univ. of Queensland, Brisbane). Nature, 214: 261 (Apr. 15, 1967).

It has been suggested that most middle-latitude sporadic E layers are formed by discontinuities in the vertical motion of the neutral gas (Nature 213: 576 (1967)). Arguments are put forward to indicate that this is not the case. (UK)

23103 MEASUREMENTS OF THE INTERPLANETARY SOLAR WIND DURING THE LARGE GEOMAGNETIC STORM OF APRIL 17–18, 1965. Gosling, J. T.; Asbridge, J. R.; Bame, S. J.; Hundhausen, A. J.; Strong, I. B. (Los Alamos Scientific Lab., N. Mex.). Contract W-7405-eng-36. J. Geophys. Res., 72: 1813-21(Apr. 1, 1967). (LA-DC-8340).

During the large geomagnetic storm of April 17–18, 1965, measurements of the solar wind were made with electrostatic analyzers on the Vela 2 satellites. A number of the observed solar wind changes can be related to worldwide geomagnetic changes; the most impressive event occurred after the main phase development when a fivefold increase in the solar wind density resulted in a sudden geomagnetic impulse. During the initial phase of the storm the plasma measurements were not complete, but the evidence indicates that the wind pressure increased at the time of the sudden commencement, and other features of the initial phase seem to have been related to solar wind changes. However, the main phase of the storm developed during a period when the solar wind remained relatively steady; further, there was nothing abnormal about the magnitude of the velocity, temperature, or proton density at that time. The α-particle flux during this period was higher than usual. The storm recovery was characterized by a period of rising solar wind velocity and temperature. (auth)

23104 MARINER 2 OBSERVATIONS OF THE SOLAR WIND. 2. RELATION OF PLASMA PROPERTIES TO THE MAGNETIC FIELD. Neugebauer, Marcia; Snyder, Conway W. (California Inst. of Tech., Pasadena). J. Geophys. Res., 72: 1823-8(Apr. 1, 1967).

Some of the relations between the interplanetary magnetic field and the positive-ion component of the solar wind as observed by Mariner 2 are summarized. Both the field strength and plasma density were generally much greater than normal at the leading edge of a long-lived high-velocity stream. For most of the period of observation, the ratio of magnetic energy density to the energy density of thermal motions of the positive ions was of the order of unity. The Alfven velocity was usually in the range 30 to 100 km/sec, and, during this period, the solar-wind flow past the earth was always greater than the phase velocity of hydromagnetic waves, a necessary condition for the existence of a hydromagnetic bow shock. The Mariner 2 spectrometer, which always faced the sun, measured the proton velocity dispersion, or temperature, along the solar radius vector. The dependence of this temperature on the instantaneous direction of the magnetic field was inconsistent with the condition $T_{\parallel} > T_{\perp}$ observed by the spherical plasma spectrometers on Pioneer 6 and Vela 3, unless the plasma was much hotter when the interplanetary field was perpendicular than when the field was parallel to the solar radius vector. (auth)

23105 BEHAVIOR OF THE NIGHTTIME IONOSPHERE. da Rosa, A. V.; Smith III, F. L. (Stanford Univ., Calif.). J. Geophys. Res., 72: 1829-36(Apr. 1, 1967).

Measurements of columnar electron contents made at frequent time intervals throughout the night permit the determination of the rate at which the total content decays. It is found that at mid-latitudes this rate is correlated with the geomagnetic activity index K_p, while such correlation is negligible at lower latitudes. An annual variation of the decay rate is observed, with a maximum around June. These results are consistent with the theory that the nighttime ionosphere is maintained in part by the downward flux of electrons from the protonosphere. (auth)

23106 SOLAR TIDAL VARIATIONS OF SPORADIC E. Harris, R. D.; Waddoups, I. G. (Utah State Univ., Logan). J. Geophys. Res., 72: 1837-44(Apr. 1, 1967).

Sporadic E backscatter data have revealed two peaks of E_s activity occurring asymmetrically with respect to local noon at about 0900 and 1800 hours. These peaks were shown to move from east to west at approximately the speed of the subsolar point. Analysis of vertical incidence data at or near the backscatter sites failed to reveal definite peaks of f_0E_s corresponding to the peaks seen in the backscatter data. This leads to the conclusion that the two E_s activity peaks in backscatter data represent an increase in the amount of sky area covered by a thin or diffuse type of E_s. Fourier analysis of the E_s backscatter data reveals 24-hr, 12-hr, and 8-hr components. Magnitudes and phase angles between the E_s components and the corresponding components of the ionospheric tidal wind system are very similar and suggest that the tidal winds are the cause of the E_s variation. This appears to be the first experimental confirmation of a solar tidal variation that is exclusive of the diurnal zenith angle variation of the normal E region. (auth)

23107 LATITUDE SURVEY OF THE EQUATORIAL ELECTROJET WITH ROCKET-BORNE MAGNETOMETERS. Davis, T. N.; Burrows, K.; Stolarik, J. D. (Goddard Space Flight Center, Greenbelt, Md.). J. Geophys. Res., 72: 1845-61(Apr. 1, 1967).

Experimentally determined profiles of ionospheric current density within and near the equatorial electrojet were derived from measurements of total magnetic field. The field measurements were obtained from rocket-borne rubidium-vapor magnetometers launched near the coast of Peru during March, 1965. A normalized latitudinal cross section of ionospheric current density was obtained using the results of nine rocket flights distributed between 140 km south to 1100 km north of the magnetic equator. The lower boundary of the equatorial electrojet is near altitude 87 km. A steep vertical gradient in current density appeared near altitude 100 km, and the maximum current density 10 amp/km^2 was measured at an altitude of 107 km directly above the measured location of the magnetic equator. The contour for the half-maximum value of current density crosses the equator at altitudes of 102 km and 114 km and extends to 300 km north of the equator. The profile of current density near the magnetic equator suggests that the layer conductivity, σ_{xy} as well as the layer conductivity σ_{yy} affects the electrojet configuration and also that the electrojet distorts the magnetic field sufficiently to affect the layer conductivities. Using observatory and rocket measurements, the induced H component of the magnetic field was found to be 0.3 of the H contribution from the ionospheric current. A single nighttime rocket flight on the magnetic equator detected a very small ionospheric current opposite in direction to the eastward daytime electrojet. (auth)

23108 MEASUREMENTS OF IONOSPHERIC CURRENTS OFF THE COAST OF PERU. Maynard, Nelson C. (Goddard Space Flight Center, Greenbelt, Md.). J. Geophys. Res., 72: 1863-75 (Apr. 1, 1967).

Four Nike-Apache sounding rockets were launched off the coast of Peru, two near the magnetic dip equator and two to the north of the dip equator. Measurements were made of the magnetic field (for current density determination) with a proton magnetometer and of electron number density (proportional to conductivity) with a DC Langmuir probe. One of the dip equator flights (UNH 65-4) was launched at the time of maximum negative effect of the lunar current system. The shape of the electrojet current profile is similar to that over India but with greater intensity. It appears that the lunar current system is most likely a modulation of the solar correlated currents. North of the dip equator the low-latitude S_q currents were found to exist in two layers centered at 100 and 120 km in altitude. A reverse current, which may be a partial return current from the electrojet, was observed to the north of the electrojet at the altitude of the maximum intensity of the electrojet. (auth)

23109 NATURE OF TRAVELING IONOSPHERIC DISTURBANCES LAUNCHED BY LOW-ALTITUDE NUCLEAR EXPLOSIONS. Hines, C. O. (Univ. of Chicago). J. Geophys. Res., 72: 1877-82(Apr. 1, 1967).

The nuclear explosion of October 30, 1961, over Novaya Zemlya, resulted in major perturbations of the F-region critical frequency, even at very great ranges from the explosion site. These perturbations were interpreted in terms of long-period gravity waves, and more recently in terms of shorter-period acoustic–gravity waves. It is shown that the new interpretation is unsatisfactory, while the old is perfectly consistent with the observations if allowance is made for the obliquity of energy propagation. The results have some bearing on natural traveling ionospheric disturbances as well. (auth)

23110 MASS-SPECTROMETRIC DETERMINATION OF THE COMPOSITION OF THE NIGHTTIME TOPSIDE IONOSPHERE. Hoffman, John H. (Naval Research Lab., Washington, D. C.). J. Geophys. Res., 72: 1883-8(Apr. 1, 1967).

The concentrations of H^+, He^+ and O^+ were determined as a function of altitude by means of a magnetic mass spectrometer flown on an Argo D-4 rocket at local midnight on January 17, 1964, from Wallops Island, Virginia. The lower ionosphere consists primarily of O^+ with a transition to H^+ as the predominant ion at 430 km. He^+ never becomes the predominant species, its maximum density being $5 \times 10^3/cm^3$. The temperature calculated from scale heights of the various constituents is 700 ± 100°K. The neutral hydrogen density at 350 km is calculated, assuming chemical equilibrium between H^+ and O^+, to be $5 \times 10^6/cm^3$. (auth)

23111 ANALYTICAL STUDY OF THE D-REGION RESPONSE TO SOLAR FLARES MONITORED BY ARIEL SATELLITE (UK-1). Jayaram, R.; Chin, G. Y. (Northeastern Univ., Boston). J. Geophys. Res., 72: 1889-99(Apr. 1, 1967).

An analytical study of the D-region response to solar flare x rays is presented. A basic formalism is improvised and developed to determine the ionization and absorption characteristics of the D region. This formalism is subsequently utilized to study the effects of solar flare x-ray spectra monitored by Ariel satellite during April–May 1962. Calculated values of electron number density and excess absorption are compared with available experimental data. Only the buildup phase of the disturbance is studied since no information is available on the decay phase of x-ray flares. The decay phase is discussed hypothetically in a few cases. More recent data on solar flare x rays can be analyzed in an identical fashion. It is also shown that an electron–ion recombination coefficient of $1-3 \times 10^{-7}\ (400/T)^{½}$ cm^3 sec^{-1} results in realistic estimates of ionospheric effects. (auth)

23112 SOLAR MICROWAVE FLUX AS AN INDEX OF SUDDEN COSMIC NOISE ABSORPTION. Basu, S.; Karmakar, S. (Univ. of Calcutta). J. Geophys. Res., 72: 1901-4(Apr. 1, 1967).

Correlation study between sudden cosmic noise absorption and solar microwave flux was attempted over the period 1958–1963. It was established that the daily mean value of 10.7-cm flux and 10.7-cm burst may be used as a suitable index for SCNA. The results are explained on the basis of the hypothesis that the daily mean value is an index of the emission of ionizing radiations from the sun that affect the lower layers of the ionosphere to cause SCNA, and the microwave burst is a measure of the flash phase of ionization. (auth)

23113 SEVERAL OBSERVATIONS OF LOW-ENERGY PROTONS AND ELECTRONS IN THE EARTH'S MAGNETOSPHERE WITH OGO 3. Frank, L. A. (Univ. of Iowa, Iowa City). J. Geophys. Res., 72: 1905-16(Apr. 1, 1967).

Simultaneous observations of proton (190 eV ≤ E ≤ 48 keV) and electron (170 eV ≤ E ≤ 46 keV) differential energy spectrums during segments of three outbound traversals of OGO 3 through the magnetosphere for the period June 11–15, 1966, on L shells 3.3–16 are presented. Proton intensities at L = 4 on June 15, 1966,

were 8×10^5 (cm^2 sec ster)$^{-1}$ ($330 \leq E \leq 530$ eV), $\lesssim 1.5 \times 10^6$ (cm^2 sec ster)$^{-1}$ ($4.7 \leq E \leq 7.6$ keV), and $\lesssim 10^6$ (cm^2 sec ster)$^{-1}$ ($16 \leq E \leq 26$ keV) and at $L = 7.5$ were $\leq 5 \times 10^4$ (cm^2 sec ster)$^{-1}$ ($330 \leq E \leq 530$ eV), 4×10^6 (cm^2 sec ster)$^{-1}$ ($4.7 \leq E \leq 7.6$ keV), and 6×10^6 (cm^2 sec ster)$^{-1}$ ($16 \leq E \leq 26$ keV) with local pitch angles 78° (± 4°) and at a geomagnetic latitude 23° (± 1°). Peak intensities of protons ($30 \leq E \leq 48$ keV) were observed at $L \simeq 7.0$. A preliminary order-of-magnitude estimate of the total energy of trapped protons (190 eV $\leq E \leq$ 48 keV) within the earth's magnetosphere is 5×10^{21} ergs, and the estimated contribution from this low-energy proton distribution to the quiet-time terrestrial ring current field at the earth's surface is $\sim -10\ \gamma$. A transient, narrow peak of relatively high low-energy proton and electron intensities within the energy range ~300 eV-2 keV at $L \simeq 4$ with width $\Delta L \sim 1$ is also observed. Typical characteristics of proton and electron intensity "spikes" at peak intensities in the late evening sector of the earth's magnetic tail are (1) approximately equal proton (190 eV $\leq E \leq$ 48 keV) and electron (170 eV $\leq E \leq$ 46 keV) energy densities $\sim 10^{-9}$ erg (cm)$^{-3}$ each, (2) approximately equal proton and electron densites over the above energy range ~1 (cm)$^{-3}$ each, and (3) largely dissimilar differential energy spectrums, proton spectrums with intensity peaks noncoincident in energy with those of the electron intensity peaks and significantly broader (harder) in the high-energy tail ($E \geq 3$ keV) than the relatively steep (soft) electron spectrums in this energy range. (auth)

23114 MODEL OF SOLAR WIND STRUCTURE. Michel, F. C. (Rice Univ., Houston, Tex. Manned Spacecraft Center, Houston, Tex.). J. Geophys. Res., 72: 1917-32(Apr. 1, 1967).

Modulation of the solar wind and the observable granularity of the solar surface are attributed to a common agent and are thereby interrelated. The scale and lifetime of solar features then suggest that the solar wind has a cellular structure with characteristic lengths of about 25 earth radii (R_E) parallel and 100 R_E perpendicular to the solar radius vector. Several ways are examined to experimentally determine these characteristic lengths. The lines of force are expected to conform closely to the gardenhose configuration although they will be locally deformed. The cellular solar wind structure is expected to be dynamically stable by the time it reaches the earth's orbit, hence the total pressure is essentially constant (isobaricity). Arguments are presented that suggest the absence of appreciable turbulent motion in the quiet-time solar wind. The enhanced variability observed in the magnetopause is attributed simply to compression by the earth's bow shock of the isobaric inhomogeneities. Such a medium is incapable of particle acceleration via the second-order Fermi mechanism. It is shown that a nonthermal tail can result from the lumping together of data obtained in regions of differing temperature. (auth)

23115 MOLECULAR ION CONCENTRATION AROUND A DAWN–DUSK AURORAL-ZONE SATELLITE ORBIT. Knudsen, W. C.; Sharp, G. W. (Lockheed Palo Alto Research Lab., Calif.). J. Geophys. Res., 72: 1941-9(Apr. 1, 1967).

Molecular ion concentration $n(O_2^+ + NO^+)$ was obtained from a curve-fitting technique applied to characteristic curves of a retarding potential analyzer carried on an oriented satellite for four days in April, 1962. Data were obtained continuously around the orbit, whose orientation was such that most data were obtained at local times near dawn and dusk. Apogee (516 km) and perigee (210 km) occurred on the dawn and dusk sides of the orbit, respectively. At or near the magnetic equator on the dusk side of the orbit, a trough in $n(O_2^+ + NO^+)$ developed with a trough-to-shoulder ratio that varied between one-half and one-fifth. The ratio $n(O^+)/n(O_2^+ + NO^+)$ tended to remain constant with universal time over the portion of the orbit near perigee (local time ≃ 1700 hr). The concentrations $n(O^+)$ and $n(O_2^+ + NO^+)$ varied individually by as much as a factor of 2–3. The time average value of $n(O_2^+ + NO^+)$ was found to be 4×10^4 cm^{-3} from 15 to 45°N invariant latitude at a local time of 1700 hr. On some orbits there is indication of a significant decrease of molecular ion concentration in the northern auroral zone when compared to latitudes south of the zone. The molecular and total ion concentrations near perigee exhibited a universal time variation with a 24-hour period, which may either be the result of a longitudinal variation in these quantities or the result of some broad-latitude universal-time variation. (auth)

23116 MEASUREMENTS OF THE SOLAR WIND AND THE SMALL-SCALE STRUCTURE OF THE INTERPLANETARY MEDIUM. Hewish, A.; Dennison, P. A. (Cambridge Univ., Eng.). J. Geophys. Res., 72: 1977-8(Apr. 1, 1967).

Observations of the solar wind made during February–July, 1966, using the interplanetary scintillation technique are described. The measurements provide the first indication of conditions far from the plane of the ecliptic. Evidence is obtained for an increase of solar wind magnitude at high heliocentric latitudes while the direction is radial within the experimental uncertainty. The plasma density fluctuations that cause scintillation have a scale comparable to the ion cyclotron radius at distances in the range 0.4–0.9 AU from the sun. (auth)

23117 VELA SATELLITE OBSERVATIONS OF SOLAR WIND IONS. Hundhausen, A. J.; Asbridge, J. R.; Bame, S. J.; Strong, I. B. (Los Alamos Scientific Lab., N. Mex.). J. Geophys. Res., 72: 1979-87(Apr. 1, 1967). (LA-DC-7947).

Observations of solar wind ions were made with the electrostatic analyzers of the Vela 2 and Vela 3 satellites. Analysis of data obtained between July, 1964, and July, 1965, by the two Vela 2 satellites leads to the following generalizations concerning the properties of the solar wind. The solar wind velocity varies in magnitude between 280 km sec^{-1} and 750 km sec^{-1}; during quiet conditions it is usually near 320 km sec^{-1}. The variation in direction is over ~15°. For periods as long as an hour the deviation from radial flow may be as large as 10°. When averaged over the year of observation, the flow is from ~1½° east of the sun. The proton temperatures in a direction transverse to the bulk velocity range from 8×10^5°K down to 6×10^3°K. The lowest temperatures measured approach the limit set by instrumental resolution; these extreme values are rarely observed. Low temperatures (typically a few times 10^4°K) are observed when the solar wind velocity is near the low end of its range, high temperatures when the velocity is high. On the Vela 3 satellites, measurements are made at more energy steps; hence the data contain more detailed information on the plasma properties. Two-dimensional mappings of the ion distribution functions in velocity space are obtained. These mappings reveal significant anisotropies in the random motions of the ions. A "tail" of nonthermal particles is usually present; the mean random energy (or temperature) of the ions is higher in the direction of this tail than in all other directions. The average direction of this tail of particles is close to the average direction of the interplanetary magnetic field. (auth)

23118 OBSERVATIONS OF SOLAR WIND PLASMA CHANGES ACROSS THE BOW SHOCK. Argo, H. V.; Asbridge, J. R.; Bame, S. J.; Hundhausen, A. J.; Strong, I. B. (Los Alamos Scientific Lab., N. Mex.). J. Geophys. Res., 72: 1989-94(Apr. 1, 1967). (LA-DC-7948).

The Vela 3 satellites are in nearly circular orbits tilted at 60° to the ecliptic plane at geocentric distances of approximately 18.5 R_E (earth radii). Thus the solar wind plasma can be sampled on both sides of the "bow shock," on both the dawn and dusk sides of the earth–sun line, and at positions both in the ecliptic plane and far above and below it. An analysis of 13 crossings of the bow shock during July and August, 1965, selected on both the dawn and dusk sides of the magnetosphere and with widely variable ecliptic latitudes show the solar wind bulk velocity to fall by ~30% as the magnetosheath is entered. The density jumps by a factor of 2–5 typically, and the proton "temperature" by a factor of ~20. Multiple crossings of the shock front are common, and each crossing is easily recognized by the distinctly different characteristics of the solar wind plasma and magnetosheath plasma. For this time period typical average values of the bulk velocity and proton temperature near the shock front in the magnetosheath were 275 km/sec and 10^6°K. Thus the bulk velocity is larger than the mean thermal velocity, showing that most of the proton energy is associated with the ordered flow of the plasma around the magnetosphere. (auth)

23119 THE EARTH'S BOW SHOCK WAVE. Tidman, D. A. (Harvard College Observatory, Cambridge, Mass.). J. Geophys. Res., 72: 1799-1808(Apr. 1, 1967).

A model for a strong plasma shock wave with a structure determined by ion wave instabilities was developed. The magnetic field structure of the shock wave is further investigated and found to have many features in agreement with satellite observations of the earth's bow shock. A significant test for this model would be to observe the plasma density to jump through the bow shock on a length scale that is sometimes less than the thickness L_B of the shock jump in the average magnetic field. It is also pointed out that the earth's bow shock may have a variable structure ranging from a thin ion-wave shock to relatively thick hydromagnetic shocks as conditions in the solar wind vary. (auth)

23120 COSMIC-RAY IONIZATION IN THE LOWER ATMOSPHERE. Lowder, Wayne M.; Beck, Harold L. (Atomic Energy Commission, New York). J. Geophys. Res., 71: 4661-8(Oct. 1, 1966).

The response of a pressurized argon-filled ionization chamber to charged particles in the cosmic radiation near 50°N geomagnetic latitude was determined as a function of atmospheric depth from mountain altitudes to sea level. The γ contributions to the various ionization chamber readings were subtracted out by utilizing concurrent determinations of the γ ionization from γ-ray energy spectra obtained with a scintillation spectrometer. Conversion of relative response to absolute free air ionization is accomplished

by normalizing the mean chamber reading at sea level to a calculated value of 2.1 ± 0.1 ion pairs cm^{-3}/sec^{-1} atm^{-1} (STP), derived from existing experimental data on muon, electron, and proton fluxes and energy distributions. The curve of absolute ionization versus atmospheric depth has the same shape as that obtained by Millikan in 1932, but with significantly lower absolute values. It is inferred that many present determinations of free-air ionization, primarily conducted at higher altitudes, may be as much as 50% too high. (auth)

23121 INNER-ZONE ELECTRONS IN 1964 AND 1965. Paulikas, G. A.; Blake, J. B.; Freden, S. C. (Aerospace Corp., El Segundo, Calif.). J. Geophys. Res., 72: 2011-20(Apr. 1, 1967).

Measurements of the fluxes and spectra of energetic ($E_e \gtrsim 0.8$ MeV) electrons were made in 1964 and 1965 with satellites 1964-45A and 1965-78A (OV1-2) in the inner radiation belt. At the time of these measurements the trapped electron flux was still dominated by artificially injected electrons dating from the Starfish test. In December 1964 the peak flux of electrons with $E_e \gtrsim 4.5$ MeV was located at the magnetic equator at L = 1.35; the flux there was 10^6 cm^{-2} sec^{-1}. Decay times of electrons ($E_e \gtrsim 4.5$ MeV) at the magnetic equator are 197 ± 22 days at L = 1.25, 442 ± 93 days at L = 1.40 and 373 ± 67 days at L = 1.50. The decay times do not appear to differ significantly for electrons >1.6 MeV. The electron spectrum above 1.6 MeV softens with increasing L for L > 1.5; the spectrum varies only weakly along field lines. (auth)

23122 POSSIBLE HELIUM ION EFFECTS IN MICROPULSATION SPECTROGRAMS. Dowden, R. L. (Univ. of Otago, Dunedin, New Zealand). J. Geophys. Res., 72: 2029-31(Apr. 1, 1967).

The effects of helium in the outer magnetosphere on micropulsation spectrograms are considered. Phase and group refractive indices are shown for longitudinal propagation in a magnetosphere of 3% helium (He^+) and 97% hydrogen (H^+). The dispersion effects of helium ions in the outer magnetosphere are pointed out. (J.H.M.)

23123 GEOMAGNETIC MICROPULSATIONS AND ELECTRON BREMSSTRAHLUNG IN THE NORTHERN AURORAL ZONE. Wilhelm, Klaus (Max-Planck-Institut fuer Aeronomie, Lindau/Harz, Ger.). J. Geophys. Res., 72: 1995-9(Apr. 1, 1967).

Geomagnetic micropulsations in the 0.005- to 1-cps frequency range were recorded at Kiruna, Sweden, in 1964 and 1965. At the same time, measurements of auroral x rays were performed by balloon-borne detectors from several stations in northern Scandinavia. A comparison of the micropulsation recordings with x-ray measurements showed a rather close connection between peaks of the x-ray intensity and the occurrence of irregular micropulsations from 1800 to 0600 LT but only a loose connection during the other half of the day. Several geomagnetic pulsation events of the Pc 1 type were also observed at times of enhanced x-ray flux. In two cases, variations of the x-ray energy spectrums were accompanied by frequency shifts of the Pc 1 micropulsations. Further, a special type of micropulsations occurring on slightly magnetically disturbed days was found. This type is characterized by sliding frequencies. Usually the frequency decreased from 0.05 to 0.01 cps in about 1 hr during the course of such events. The frequency shift is tentatively interpreted as being caused by a moving source of perturbations in the magnetopause. (auth)

23124 THE TEMPERATURE OF THE F REGION DEDUCED FROM ELECTRON NUMBER-DENSITY PROFILES. Becker, Walter (Max-Planck-Institut fuer Aeronomie, Lindau/Harz, Ger.). J. Geophys. Res., 72: 2001-6(Apr. 1, 1967).

Electron number-density-height profiles of the ionosphere were deduced from ionograms taken at Lindau/Harz during noon intervals and years of high and low solar activity. The curvature of these profiles close to the F2 peak was determined by a parabolic approximation and expressed by the half-thickness Y_m of this parabola. These Y_m values proved to be proportional to the respective neutral gas temperature at the peak as deduced from satellite drag measurements. The upper and lower limits were ±10%, respectively. This result differed from recent theoretical studies and suggested more detailed studies in this field. The seasonal peak height variation of the F2 layer was shown to mirror the exospheric temperature anomaly. It was concluded that both anomalies might have the same origin, namely, dynamical effects in the ionosphere and exosphere. In completion, data on the heating of the ionosphere during mean geomagnetic disturbances deduced by a lunar tidal analysis of the same real height data were added. A rate of 5.8°K per unit of A_p was found. (auth)

23125 CORRELATION BETWEEN SOLAR ACTIVITY AND THE ATMOSPHERIC POTENTIAL GRADIENT AT THE EARTH'S SURFACE IN THE POLAR REGIONS. Sao, K. (Univ. of Nagoya, Japan). J. Atmos. Terrest. Phys., 29: 213-15(Feb. 1967).

The atmospheric potential gradient measured near the ground in polar regions is shown to be correlated with solar radio emission at 1000 Mc. (UK)

23126 THE EQUATORIAL ELECTROJET AND THE WORLD-WIDE S_q CURRENTS. Ogbuehi, P. O.; Onwumechilli, A.; Ifedili, S. O. (Univ. of Ibadan, Nigeria). J. Atmos. Terrest. Phys., 29: 149-60(Feb. 1967).

The correlation results presented give the relations between various parts of the S_q currents. Of three hypotheses which are used in explaining available results the most successful is that which considers the electrojet as a current circuit whose return path and intensity variations are different from those of the world-wide S_q. (UK)

23127 EFFECT OF A SOLAR ECLIPSE ON ATMOSPHERIC POTENTIAL GRADIENTS. Kamra, A. K.; Varshneya, N. C. (Univ. of Roorkee, India). J. Atmos. Terrest. Phys., 29: 327-9(Mar. 1967).

A continuous record of the atmospheric potential gradient during the period of the solar eclipse of 20th May, 1966, is presented. The recorded values show a marked deviation from those normally observed at the same time of day. They show the potential gradient negative for most of the time, with a regular variation pattern having five clear peaks. (auth)

23128 STRUCTURE OF QUASI-SHOCKS IN A COLLISION-FREE PLASMA IN A MAGNETIC FIELD. Cordey, J. G. (Culham Lab., Abingdon, Eng.); Saffman, P. G. J. Plasma Phys., Pt. 1, 1: 129-44(Feb. 1967).

A study is made of finite amplitude, oblique, hydromagnetic waves in a cold collision-free plasma. It is shown that the equations admit steady solutions which describe flow through a front. Ahead of the front, the flow is uniform, but behind the front the magnetic field and flow variables oscillate irregularly in a random manner. The fronts are called "quasi-shocks," although they have more in common with the laminar-turbulent transition of fluid mechanics than with the classical shock wave. The structure of the quasi-shocks is examined, and estimates are made for the mean values behind the front. The relevance of the quasi-shocks to the so-called "collision-free shock" is considered, and comparison is made with the "bow shock" on the solar wind near the earth. It is shown that the quasi-shock is consistent with some of the observed data. (auth)

23129 FORMATION OF EQUATORIAL ELECTROJET CURRENT LAYERS. Singh, R. N.; Misra, K. D. (Banaras Hindu Univ., India). Nature, 214: 375-6(Apr. 22, 1967).

The electrojet layer is generally considered to be a thin equatorial charged particle layer sandwiched between two nonconducting layers. In the equatorial region the magnetic field becomes horizontal and is perpendicular to the equatorial belt encircling the earth. Because of the presence of a horizontal magnetic field the charged particles experience a Lorentz force and move in opposite directions. The particles are accumulated on the lower and upper nonconducting boundaries. The magnitude of charge accumulation is such that further flow of Hall current is completely inhibited. Cowling conductivity may be increased considerably under favourable conditions and results in a strong electrojet current along the equatorial belt. The magnitude of the electrojet current depends on the degree of inhibition of the Hall current. When the Hall current is incompletely inhibited enhancement of electrojet current is less pronounced. The assumed sandwiching ionospheric boundaries are partially conducting and some charge leaks out. Measurements of equatorial jet currents by rockets produced evidence for two current layers, a prominent layer at a height of about 100 km, and a less prominent layer at 120 to 150 km for which there is no theoretical establishment. The presence of sporadic-E radiation would change the Cowling conductivity considerably, and result in a prominent second electrojet current layer. In the absence of a sporadic-E layer the degree of Hall current inhibition would be comparatively quite low, giving rise to a comparatively weaker second electrojet current layer. The rocket flights showed considerable variations in the height and magnitude of the second layer. Graphs are presented showing variation of current density with height measured by rocket flights, and variation of effective Cowling conductivity with height. (UK)

23130 IONOSPHERIC NO-ECHO OCCURRENCES. Schaeffer, R. C. (Univ. of Adelaide). Nature, 214: 376(Apr. 22, 1967).

The absence of ionospheric echoes at vertical incidence at stations in high latitudes is usually attributed to increased ionisation in the D region, causing strong absorption of radio waves, and usually associated with a disturbed magnetic field. In the studies reported the relation between no-echo conditions and absorption of cosmic radio noise, as measured with a riometer, was investigated, using data obtained during 1963 from the Mawson

Station of the Australian National Antarctic Research Expeditions. Curves are reproduced comparing diurnal variation of percentage hourly occurrence of no-echo conditions with quarter-hour maxima of ionospheric absorption of cosmic radio noise for the winter months. During the interval 1500 to 2000 hours no-echo occurrences were much more frequent than expected from absorption records. A similar anomaly has been reported at about 1900 hours. It is suggested that this anomalous high frequency of no-echo conditions is due simply to lack of ionisation in the E and F regions. This explanation is consistent with other observations at Mawson. No-echo occurrences are less frequent during the summer months, because F-region ionisation is relatively high. (UK)

23131 SPECTROSCOPIC STUDIES OF THE TWILIGHT AIRGLOW. Hunten, Donald M. (Kitt Peak National Observatory, Tucson, Arizona). Space Sci. Rev., 6: 493-573(Feb. 1967).

Observational methods used in the study of twilight emission and methods of analyzing the observations are described. Twilight phenomena in the upper atmosphere are discussed under the following: metallic emissions, Na, K, Li, and Ca^+; O_2 and OH bands; and F-region emissions. (J.H.M.)

Low-Temperature Physics

Refer also to abstract 23155.

23132 (AD-643781) SUPERCONDUCTIVITY IN ONE AND TWO DIMENSIONS. II. CHARGED SYSTEMS. Rice, T. M. (California Univ., La Jolla, San Diego. Dept. of Physics). Aug. 9, 1966. Contract Nonr-2216(11). 44p. (TR-41). CFSTI $3.00 cy, $0.65 mn.

In an earlier paper the Ginzburg–Landau free energy functional was used to calculate the effect of thermodynamic fluctuations on the off-diagonal correlation function and no off-diagonal long-range order was found in one- and two-dimensional systems. It has been pointed out that for a charged system the use of the Ginzburg–Landau free energy functional is in error for arbitrary nonequilibrium values of the order parameter since the electrostatic energy of the charge fluctuations associated with an arbitrary order parameter is not included in the free energy functional. A direct generalization of the free energy functional was not achieved. It was found that for uncharged systems the RPA gives a linearization of the results obtained earlier using the Ginzburg–Landau theory. For charged systems the RPA results were similar to those obtained for uncharged systems. It was concluded that it is very likely that, as in uncharged systems, there will be ODLRO in charged infinite one- and two-dimensional systems. (auth)

23133 (AD-644028) THE BOGOLYUBOV EQUATIONS AND THEIR APPLICATION TO A NORMAL–SUPERCONDUCTING BOUNDARY. Mathews, Wesley Northey (Illinois Univ., Urbana). 1966. Contract DA-31-124-ARO(D)-114. 212p. (AROD-431:79) CFSTI $3.00 cy, $0.65 mn.

Thesis.

The Bogolyubov equations are used to investigate the pair potential and the electronic excitations associated with a normal–superconducting boundary in an extreme type I superconductor. (auth)

23134 (AD-644182) ULTRASONIC AND THERMAL EFFECTS IN SUPERCONDUCTORS. Kagiwada, Reynold S. (California Univ., Los Angeles. Dept. of Physics). Dec. 1966. Contract Nonr-233(48). 148p. (TR-26). CFSTI $3.00 cy, $0.65 mn.

Some of the properties of three transition metals, niobium, vanadium, and tantalum, were investigated using the ultrasonic technique. The normal attenuation in niobium possessed a typical electron–phonon behavior with a temperature dependence of $T^{-3.2}$. In the superconducting state, attenuation was measured in both the absence of a magnetic field and at various values of the external magnetic field. From the ratio of superconducting-to-normal-conducting attenuation, the zero-degree energy gaps of niobium, vanadium, and tantalum were determined. For niobium, an energy gap of $2\Delta(0) = 3.64 \pm 0.05\ kT_c$ was found for the 100 direction of propagation, and an energy gap of $3.70 \pm 0.06\ kT_c$ for the 111 direction. These measurements indicate an anisotropy of the energy gap. The zero-degree energy gap for vanadium was $2\Delta(0) = 3.40 \pm 0.07\ kT_c$ in the 110 direction, and $3.10 \pm 0.07\ kT_c$ for tantalum in the 100 direction. (auth)

23135 (AD-644536) POTENTIAL AND MAGNETIC MOMENT OF A SUPERCONDUCTING TORUS IN A NONAXIAL UNIFORM MAGNETIC FIELD. Wright, Evan B.; Peterson, Paul I. (Naval Research Lab., Washington, D. C.). Oct. 18, 1966. 22p. (NRL-6429). CFSTI $3.00 cy, $0.65 mn.

The magnetic constants of an ideal superconducting torus, located in a uniform magnetic field perpendicular to its axis of symmetry, are calculated from a scalar potential expansion in toroidal Legendre functions. An algorithm for finding the expansion coefficients, suitable for digital computation, is included. Graphs and approximate formulas are given for the induced magnetic moment of the torus and the maximum field values (with locations) on its surface, as functions of its radius ratio. (auth)

23136 (CEA-R-2987) REALISATION D'UN APPAREIL POUR DES MESURES D'ORIENTATION NUCLEAIRE A BASSE TEMPERATURE. APPLICATION A L'ALLIAGE NEODYME–COBALT. (Construction of an Apparatus for Nuclear Orientation Measurements at Low Temperatures. Application to Neodymium–Cobalt Alloy). Mayer, Eric (Commissariat a l'Energie Atomique, Grenoble (France). Centre d'Etudes Nucleaires). 1966. 61p. (In French). Dep. mn.

Thesis. Submitted to Univ., Grenoble, France.

The anisotropy of γ radiations emitted by oriented nuclei was studied. The great hyperfine fields acting on nuclei in ferromagnetic metals to produce alignment at low temperature were used. By irradiation ^{60}Co nuclei were obtained in the samples, which were then cooled down to 0.01°K. The anisotropic rate of the 1.33-MeV γ radiation was measured as a function of the sample temperature, using as a thermometer the anisotropy of γ radiation emitted by ^{60}Co nuclei in a Co single crystal. ^{60}Co was lined up in a Co–Ni alloy (40% Ni). The hyperfine field at the cobalt was measured compared to the effective field in metallic cobalt: $H_{eff\ Co-Ni}/H_{eff\ Co\ metal} = 0.71 \pm 0.12$. These results are in good agreement with specific heat measurements of Arp, Edmonds, and Petersen. (auth)

23137 (SC-T-67-0915) EFFECT OF ORDERING OF SCREW DISLOCATIONS ON THE LATTICE THERMAL CONDUCTIVITY AT LOW TEMPERATURES. Gruner, Peter. Translated by Marcel I. Weinreich (Sandia Corp., Albuquerque, N. Mex.), from Z. Naturforsch., 20a: 1626-39(1965). 28p. Dep. mn. CFSTI $3.00 cy, $0.65 mn. JCL $2.60 fs, $1.04 mf.

The thermal resistance of screw dislocations arranged in a particular way is calculated, using nonlinear elastic theory. It is shown that above liquid He temperatures the arrangement does not matter and the thermal resistance of a group of dislocations is, to a good approximation, the same as for a random distribution. Below 4°K the thermal conductivity increases more rapidly than quadratically with temperature. (auth)

23138 (UCRL-17380) DEMONSTRATION OF FLUX QUANTIZATION AND THE JOSEPHSON EFFECT IN SUPERCONDUCTORS. Richards, P. L.; Grimes, C. C.; Shapiro, S. (California Univ., Berkeley. Lawrence Radiation Lab.). Jan. 1967. Contract W-7405-eng-48. 9p. (CONF-670109-9). Dep. mn. CFSTI $3.00 cy, $0.65 mn.

From Annual Meeting of the American Physical Society, New York.

Two recent developments in the study of superconductivity, flux quantization and the Josephson effect, are demonstrated with relatively simple apparatus. These experiments are intended to complement the discussion in Feynman's Lectures on Physics, Vol. III. (auth)

23139 (USC-113P16-3) A STUDY OF MAGNETIC, THERMAL, AND TRANSPORT CURRENT PHENOMENA IN TYPE II SUPERCONDUCTORS. Summary Progress Report, 1966. LeBlanc, M. A. R. (University of Southern California, Los Angeles. Dept. of Electrical Engineering). Dec. 1966. Contract AT(11-1)-113. 17p. Dep. mn. CFSTI $3.00 cy, $0.65 mn.

The conduction current in wires of type-II superconductors ($Nb_{0.75}Zr_{0.25}$, $Nb_{0.5}Ta_{0.5}$) was found to flow in paramagnetic helical paths in the presence of axial magnetic fields. An alternating current in wires of type-II superconductors ($Nb_{0.75}Zr_{0.25}$, $Nb_{0.5}Ta_{0.5}$) in the presence of a static axial magnetic field was observed to give rise to a longitudinal magnetization whose amplitude varies at twice the frequency of the alternating current. Magnetization currents induced by the removal of an axial magnetic field enabled considerably enhanced conduction currents to flow in the wire (Nb_3Zr) before a critical threshold was attained. Alternatively, the presence of a conduction current in the wire immersed in an axial magnetic field was seen to lead to appreciably amplified magnetization currents when the magnetic field was reduced. Wires of Nb_3Zr were found to support unidirectional varying currents of amplitude comparable to the "virgin" dc level but to exhibit considerable critical current degradation when currents of varying polarity were impressed above a threshold value. Detailed measurements revealed that a significant fraction of the conduction current flowed in a surface sheath in Nb_3Zr ribbons immersed in transverse magnetic fields. A modified Silsbee relation between a lower critical field $H_{c1}^{\dagger} > H_{c1}$ and I_{co} the critical current in zero applied field was found to hold in $Nb_{0.5}Ta_{0.5}$ wires, e.g. $I_{co} = 5R\ H_{c1}^{\dagger}$. Resonance-

like behavior in the residual magnetization of $Nb_{0.5}Ta_{0.5}$ wires versus the maximum applied magnetic field was noted. Enhancement of the partial Meissner effect in wires of $Pb_{0.84}In_{0.16}$ by a heat pulse was discovered indicating that a paramagnetic current is induced in the surface sheath during cooling below T_c in a static magnetic field. All of the new phenomena listed above were satisfactorily interpreted in terms of simple physical models exploiting the concepts of (i) a surface sheath existing between O and H_{c2}, (ii) interaction of flux filaments with imperfections and each other and (iii) a driving Lorentz force $\vec{j} \times \vec{B}$. (auth)

23140 (ORNL-tr-1600) INVESTIGATION OF THE INTERACTION OF MAGNETIC FLUX LINES WITH DISLOCATIONS AND SURFACES IN NIOBIUM. [PART] I. Nembach, E. Translated for Oak Ridge National Lab., Tenn., from Phys. Status Solidi, 13: 543-58(1966). 23p. Dep. mn, CFSTI $3.00 cy, $0.65 mn, JCL $2.60 fs, $0.89 mf.

A study is made of the effect of planar arrays of dislocations on flux penetration into niobium single crystals at 4.2°K. The dislocation densities ρ are measured by etch pits and by electron transmission. The measured hysteresis (in particular trapped flux) is used to calculate the interaction force between an Abrikosov flux line and the dislocations lying perpendicular to it. For ρ between 2×10^5 and 5×10^{10} cm^{-2} the measured interaction force varies between 4×10^{-7} and 1.4×10^{-4} dynes/cm, and it is proportional to $\sqrt{\rho}$. The interaction between flux lines and surfaces is studied following various surface treatments. In agreement with simple theory this interaction leads to hysteresis without trapped flux. (auth)

23141 EFFECTS OF ^{3}He–^{3}He INTERACTIONS IN DILUTE SOLUTIONS OF ^{3}He IN ^{4}He. Ebner, C. (Univ. of Illinois, Urbana). Phys. Rev., 156: 222-9(Apr. 5, 1967).

The classical gas expression for the diffusion coefficient and experimental measurements of the spin diffusion coefficient of a 5% solution of ^{3}He in ^{4}He at temperatures up to 1°K were used to extend the effective interaction between ^{3}He quasiparticles, as derived by Bardeen, Baym, and Pines, to larger values of the momentum. This potential is then used in first-order perturbation theory to calculate the high-temperature magnetic susceptibility of dilute solutions and the variation in the ^{3}He chemical potential with concentration. From the latter, and from measurement of the phase-separation curve at finite temperature, the maximum solubility of ^{3}He in ^{4}He is determined down to T = 0. Agreement with experiment is good. (auth)

23142 EFFECTIVE INTERACTION OF ^{3}He ATOMS IN DILUTE SOLUTIONS OF ^{3}He IN ^{4}He AT LOW TEMPERATURES. Bardeen, J.; Baym, G.; Pines, D. (Univ. of Illinois, Urbana). Phys. Rev., 156: 207-21(Apr. 5, 1967).

The approximate form of the effective interaction between ^{3}He atoms in superfluid ^{4}He is derived from the experimental data on spin diffusion and phase separation in dilute mixtures of ^{3}He in ^{4}He. The interaction is weak, and attractive at long wavelengths. Calculations of the Fermi-liquid parameters for the normal state of ^{3}He in solution yield results for the effective mass and spin susceptibility in agreement with experiment. The temperature for a superfluid transition associated with the ^{3}He is estimated to be $\sim 2 \times 10^{-6}$ °K; the maximum solubility of ^{3}He in ^{4}He is found to be ~6% at T = 0. Thermodynamic and microscopic arguments are used to calculate the long-wavelength part of the effective interaction between the ^{3}He atoms. The contribution arising from the exchange of a virtual ^{4}He phonon is shown to be large and attractive, while the remaining part of the interaction is almost as large but repulsive; the calculated interaction at long wavelengths is thus weak and attractive and is in excellent agreement with that determined empirically; the physical origin of the weakness of the interaction is that ^{3}He is an isotopic impurity. Finally, it is estimated that the application of pressure serves to weaken the effective interaction. (auth)

23143 INTERACTION OF CONDUCTION AND INDUCED CURRENTS IN Nb_3Zr WIRES SUBJECTED TO AXIAL FIELDS. Belanger, B. C.; LeBlanc, M. A. R. (Univ. of Southern California, Los Angeles. Aerospace Corp., Los Angeles). Appl. Phys. Lett., 10: 298-300(May 15, 1967).

A residual magnetization induced in Nb_3Zr wires by axial fields appreciably enhances I_c. Further, the presence of a conduction current as an axial field H_z is removed not only leads to considerably increased residual moments but also enables the wire to support currents at H = 0 much larger than is possible in the virgin state. (auth)

23144 SUPERCONDUCTING LINES FOR THE TRANSMISSION OF LARGE AMOUNTS OF ELECTRICAL POWER OVER GREAT DISTANCES. Garwin, R. L. (Columbia Univ., New York); Matisoo, J. Proc. IEEE (Inst. Elec. Electron. Eng.), 55: 538-48 (Apr. 1967).

As an application of high-field high-current superconductors, a design was sketched for a power transmission line to carry 100 GW (10^{11} watts) of direct current over a distance of 1000 km. Such a line, in contrast to one made of ordinary metal, would dissipate none of the power transmitted through it, although it is necessary to tap power from the line for refrigeration. The consequences of negligible transmission loss are substantial: power transmission would be more economical than the present practice of shipping coal to the region in which electricity is generated and consumed; generating-plant site selection could be made almost entirely on economic considerations; at the same time, thermal and air-pollution problems could be minimized; novel power sources could be considered. The power line would be made of Nb_3Sn and would be refrigerated to 4°K. The power must be transmitted as dc, rather than as ac, because the very large (comparatively) ac losses would require excessive refrigeration capacity. Specifically, a line at 200 kV carrying 0.5×10^6 A is discussed. The investment in the line will be approximately $806 million, or $8.06/kW. Of this, some $6.06/kW is line cost, the remainder being converter cost. In comparison with the shipping of coal, the investment cost would be repaid in ten months. The problems of refrigeration along the line, including those of heat leak through the wires which deliver power to customers at room temperature were investigated. The efficiency of the line is greater than 99.9% (power transmitted less the power drawn off to run refrigeration equipment, all divided by transmitted power). (auth)

23145 ULTRASONIC ATTENUATION IN NORMAL AND SUPERCONDUCTING LEAD; ELECTRONIC DAMPING OF DISLOCATIONS. Hikata, A.; Elbaum, C. (Brown Univ., Providence). Phys. Rev. Lett., 18: 750-4(May 1, 1967).

Results of measurements of ultrasonic attenuation in normal and superconducting Pb as a function of wave amplitude are reported for frequencies of 10 and 20 Mc. The data are used to determine the parameter B associated with damping of dislocations by conducting electrons in the normal state. A value of 8.6×10^{-8} dyne sec cm^{-2} was obtained, which is independent of any ad hoc assumptions about inaccurately known features of the dislocation network. (A.G.W.)

23146 STATISTICAL THEORY OF A SECOND-ORDER TRANSITION IN AN INTERACTING SYSTEM. Harper, P. G. (J. J. Thomson Physical Lab., Reading, Eng.). Proc. Phys. Soc. (London), 90: 587-600(Mar. 1967).

An exact statistical-mechanical treatment of a system of monoenergetic particles with mutual interaction is given and shown to lead to a second-order phase transition. For comparison a self-consistent BCS-type treatment is developed and shown to be in substantial agreement. Fluctuations are treated and shown to come large at temperatures approaching the transition from above. (auth)

23147 THERMAL CONDUCTIVITY OF PURE ^{3}He AND OF DILUTE SOLUTIONS OF ^{3}He IN ^{4}He AT LOW TEMPERATURES. Abel, W. R. (Univ. of Illinois, Urbana); Johnson, R. T.; Wheatley, J. C.; Zimmermann, W. Jr. Phys. Rev. Lett., 18: 737-40 (May 1, 1967).

The thermal conductivity κ of pure ^{3}He and of two dilute solutions of ^{3}He in ^{4}He has been measured from 0.03 down to 0.005°K or below. For pure ^{3}He, κT increases with increasing temperature. For the dilute solutions at low enough temperatures, κ is consistent with the T^{-1} temperature dependence of a normal Fermi liquid, but the magnitudes of κT do not agree with values computed from an effective potential based on spin-diffusion coefficient measurements. (auth)

23148 TUNNELING MEASUREMENTS ON SUPERCONDUCTORS WITH ISOTROPIC ENERGY GAPS. Walmsley, D. G.; Campbell, C. K. (McMaster Univ., Hamilton, Ont.). Can. J. Phys., 45: 1541-8(Apr. 1967).

The energy-gap anisotropy found in bulk superconductors is considerably reduced in thin films whose thickness, d, is much less than the range of coherence, ξ_0, of the pure metal from which they are fabricated. By preparing such thin films of tin, indium, and lead, the temperature dependence of the energy gap in each above 1.2°K was examined, using the tunneling technique. Values of the energy-gap parameter $2\Delta(0)/kT_c$ are given as 3.67 ± 0.07 and 3.87 ± 0.08, for tin and indium respectively, while the energy gap for lead is estimated to be $2\Delta_{Pb}(0) = 2.70 \pm 0.02$ MeV. (auth)

23149 THERMOMAGNETIC EFFECTS IN THE MIXED STATE OF TYPE-II SUPERCONDUCTORS. Ohta, Tokio (Defense Academy, Yokosuka, Japan). Jap. J. Appl. Phys., 6: 645-50(May 1967).

A phenomenological theory is developed for the thermomagnetic effects in the flux flow state of type-II superconductors. Ettinghausen-, Nernst-, and Righi–Leduc coefficients are expressed

explicitly with the use of known physical quantities. Thermal conductivity and analogous Peltier coefficient due to flux line are discussed in detail using a quasi-particle model for the flux line. It is shown that the analogous thermoelectric figure of merit in the flux flow states has large values of the order of 1/T in the perpendicular direction to the external electric current, while it is of the order of $10^{-2}/T \sim 10^{-3}/T$ in the direction parallel to the current. A possibility of a negative figure of merit is also pointed out. (auth)

23150 SUPERCONDUCTIVITY AND THE d-SHELL. Engelhardt, John J.; Webb, George W.; Matthias, Bernd T. (Univ. of California, San Diego). Science, 155: 191-3(Jan. 13, 1967).

The various isotope effects on the superconducting transition temperature of Mo_2B and W_2B were measured. Together with resistivity data they indicate that the d-shell forms a highly stable electron configuration for molybdenum and tungsten. This leads to an understanding of high superconducting transition temperatures. (auth)

23151 ADVANTAGES IN THE USE OF SUPERCONDUCTOR WINDINGS IN A MASER. Grangeon, J. (Compagnie Francaise Thomson-Houston, Bagneux, France). Onde. Elec., 47: 129-33 (Jan. 1967). (In French).

The operation of a maser-type amplifier requires the presence of a continuous magnetic field meeting certain conditions of stability, size, and orientation, and also of uniformity and controllability. The advantages and disadvantages of various ways of obtaining this magnetic field are shown and as a result the marked superiority of superconductor windings is indicated. An example of a cavity maser using these types of magnetic field generator is provided. (auth)

23152 SUPERCONDUCTIVE MAGNETS. I. THE ROLE OF CRYOGENICS. Freeman, D. C. Jr. (Union Carbide Corp., Indianapolis). Mech. Eng., 89: 46-52(Feb. 1967).

The present state of He-temperature cryogenics is reviewed and the general design factors involved are discussed together with those specifically concerned with superconductive magnets. Superconductive magnets must be operated at temperatures well below 20°K, the highest known superconducting transition temperature. Cryogenic environments for maintaining these temperatures utilize liquid He or refrigerated He gas and require extremely efficient thermal insulation. It appears that low-temperature environments in the range of 3 to 10°K are not a transitory phase in the evolution of superconductive magnets, and they may in fact be required as long as such magnets are technologically useful. Information is provided to allow the prospective user of superconductive magnets to evaluate the economic and technical significance of the cryogenics in various magnet applications. Problems in liquid-He containment are considered. Recent advances in insulation techniques have resulted in improvements by a factor of 1000 over conventional powder insulations. Loss rates of liquid He in transport and storage containers are now less than 1% per 24 hr. This factor, when coupled with available high-efficiency vacuum-insulated liquid-He transfer lines, makes the storage, transport, and handling of liquid He commercially feasible and economical. Refrigeration systems for the commercial production of large quantities of liquid He are also discussed, and special design factors for superconductive magnet cryogenics are examined. (BBB)

23153 SUPERFLUID HELIUM. A Symposium Sponsored Jointly by St. Andrews University, St. Andrews, Fife, Scotland and Arthur D. Little, Inc., Cambridge, Massachusetts, August 1965. Allen, J. F. (ed.). New York, Academic Press, 1966. 315p. $11.75. (CONF-650824).

Twenty-four papers on the phenomenology of the superfluid state of liquid helium are included. Subjects covered are hydrodynamics, vorticity, narrow channel and film flow, critical velocity, ions and ion mobility, third sound, and the unlikelihood of superfluidity in liquid ^{3}He. Two papers have appeared in NSA previously; see NSA Vol. 20, abstract Nos. 1119 and 8002. (M.H.R.)

Plasma and Thermonuclear Physics

Refer also to abstract 21916.

Confinement and Heating of Plasma

Refer also to abstracts 22067 and 22068.

23154 (UCID-15101) FAILURE ANALYSIS OF TIE-RODS ON ALICE BASEBALL MAGNET. Neef, W. S. Jr. (California Univ., Livermore. Lawrence Radiation Lab.). Aug. 31, 1966. Contract W-7405-eng-48. 29p. Dep. mn. CFSTI $3.00 cy, $0.65 mn.

A group of nine 11½-in.-diam. tie rods with threaded ends failed at 70% design load. They were made of beryllium copper and were used to constrain the large forces encountered in a magnet of baseball seam geometry. This failure occurred during routine operation of the physics experiment but on the first stress cycle at 70% load. Investigation revealed a low-cycle fatigue failure. A heat treatment had been selected which gave great strength but reduced elongation to about 3%; much too brittle a condition when the stress concentration at the threads is considered. Surprisingly little structural damage occurred except for complete destruction of the magnet. The vacuum insulation chamber surrounding the magnet and plasma chamber contained all fragments of the failed rods. The presence of personnel protection baffles around this experiment gave further assurance of the safety of operating personnel in control and diagnostic areas. (auth)

23155 (UCRL-70380) SUPERCONDUCTING BASEBALL COIL FOR PLASMA CONFINEMENT. Henning, Carl D.; Taylor, Clyde E. (California Univ., Livermore. Lawrence Radiation Lab.). Mar. 21, 1967. Contract W-7405-eng-48. 17p. (CONF-670409-1). Dep. CFSTI.

From International Cryogenic Engineering Conference, Kyoto, Japan.

Most large-scale controlled-fusion experiments of the dc mirror-machine type can advantageously use superconducting coils. These coils are not simple solenoids, but have a shape that produces a magnetic well of minimum field strength in a roughly spherical volume. Design information is presented on baseball-coil shapes, including field configuration, force distribution, and inductance. Experience with such superconducting-coil systems illustrates the particular problems of using these coils for controlled-fusion experiments. In addition, a natural-circulation liquid-helium system is described that is presently being used in the "baby-baseball" neutral-injection experiment. (auth)

23156 CONTAINMENT OF A CYLINDRICAL PLASMA STREAM BY A STRONG MICROWAVE FIELD. Sergeichev, K. F.; Gekker, I. R. (Lebedev Inst. of Physics, Moscow). JETP Lett. (USSR)(Engl. Transl.), 5: 146-9(Mar. 15, 1967).

Translated from Zh. Eksp. Teor. Fiz., Pis'ma Redaktsiyu, 5: 183-8(Mar. 15, 1967).

Experiments are reported on the containment of a transparent plasma ($\omega_{L_e} \ll \omega$) in an axisymmetric quasipotential well produced in a round waveguide by the field of a traveling H_{01} wave. (M.O.W.)

23157 MOMENTARY MAGNETIC FIELD GENERATOR. Matsuda, Jinsaku (to Tokyo Shibaura Electric Co., Ltd.). Japanese Patent 1966-7390. Apr. 22, 1966. Filed Feb. 5, 1965.

In the momentary magnetic field generator proposed, when producing a high-intensity current plasma for the purpose of thermonuclear fusion in particular, the coils for containing the plasma are short-circuited by using a plurality of ordinary discharge gap devices, instead of other devices such as ignitrons. The following devices are used: a dc power source for charging purposes; a first condenser charged by this power source; magnetic-field producing coils excited by the discharge current of this condenser; a switch for the circuit through which the discharge current flows from the first condenser; the auxiliary coils connected in series to the discharge circuit; the first discharge gap device installed in parallel with the magnetic-field producing coils; the second condenser charged at a higher level than the first condenser; an impulse voltage generator, which produces an impulse voltage when the terminal voltage of the first condenser becomes approximately zero; and the second discharge gap device, forming a circuit which is excited from the impulse voltage generator and discharges the second condenser. By discharge of the second condenser, the ionization in the first discharge gap is enhanced and a flash discharge takes place. (NSA of Japan)

Diagnostics of Plasma

Refer also to abstracts 22199 and 23219.

23158 (AD-631843) VARIATION OF ELECTRON DENSITY AND NEUTRAL GAS DENSITY ALONG A PLASMA COLUMN. Scientific Report No. 1, June 1-August 31, 1965. Nord, Ake (Kungliga Tekniska Hogskolan, Stockholm (Sweden)). Jan. 15, 1966. Contract AF 61(052)-895. 15p. (RADC-TR-66-186). CFSTI.

The axial variation of the electron density and the neutral gas density along a mercury plasma column were measured. The electron density was determined from measurements of the shift of the resonance frequency of a cylindrical microwave cavity operating in

the TM sub 010-mode. From measurement of the attenuation of mercury resonance line radiation at 2537 Å the neutral gas density was determined. Both the electron and the neutral gas densities were found to increase towards the anode. (auth)

23159 (AD-643077) MEASURED INDEX OF REFRACTION OF AN ARGON PLASMA. Final Technical Report. Hug, W. F.; Evans, D. L.; Tankin, R. S.; Cambel, A. B. (Northwestern Univ., Evanston, Ill. Gas Dynamics Lab.). July 1966. Contract AF 33(615)-1160. 58p. (ARL-66-0140). CFSTI $3.00 cy, $0.65 mn.

The index of refraction for argon over a temperature range of 10,000°K to 18,000°K is measured at a wavelength of 6328Å. A helium–neon laser is used as a light source for a Mach–Zehnder interferometer in these experiments. A commercially made plasma torch, which was modified, was used to produce the plasma jet discharging into the atmosphere. The measured index of refraction lies between the curve representing the calculated ground-state and free-electron contributions and the curve representing the "excited" electron as a free electron. (auth)

23160 (ARL-66-0222) APPLICATION OF A DIFFERENTIAL INTERFEROMETER TO AN AXIALLY SYMMETRIC ARC HEATED PLASMA. Lamb, Jimmy D.; Schreiber, Paul W. (Aerospace Research Labs., Wright-Patterson AFB, Ohio). Nov. 1966. 129p.

The refractive index of an arc-heated plasma of atmospheric argon was measured with nearly monochromatic 5463 Å light. The measurement was made with a differential interferometer, the basic components of which are two Wollaston prisms and a concave mirror. Integration of the deflection curves was performed to yield the optical path shifts relative to air as a function of lateral distance. (M.O.W.)

23161 (CEA-R-3129) DETECTION ET ANALYSE DES PARTICULES CHARGEES ET NEUTRES APPLIQUEES A L'ETUDE DES PLASMAS CHAUDS. (Detection and Analysis of Neutral and Charged Particles. Application to the Study of Hot Plasmas). Renaud, Claude (Commissariat a l'Energie Atomique, Fontenay-aux-Roses (France). Centre d'Etudes Nucleaires). Dec. 1966. 68p. (In French). (EUR-3225.f). Dep. mn.

To measure the energy spectrum of ions in a plasma, the ions must be extracted without altering the spectrum. For a dense plasma this presents difficulties, and one method is the measurement of the energy spectrum of atoms produced by charge-exchange reactions of ions with residual gas. The measurements of both the energy spectrum and the flux of atoms leaving the magnetic configuration of the device DECA II (Dispositif d'Etude de Compression Adiabatique) are made by: an ion detector which permits the measurement of ion currents $\geq 10^{-16}$A, an electrostatic analyzer of energy range 10 eV to 10 keV, a magnetic analyzer for ion momentum $\leq 10^5$ gauss-cm, and a gas cell to convert fast atoms into ions. (auth)

23162 (CLM-R-68) POTASSIUM BEAM PROBE FOR THE MEASUREMENT OF ELECTRON DENSITY. Hill, J. W.; Mason, D. W.; Travis, A. (United Kingdom Atomic Energy Authority, Abingdon (England). Culham Lab.). Dec. 1966. 9p. Dep. mn. CFSTI $3.00 cy, $0.65 mn. HMSO 1s. 2d.

An apparatus for the production and detection of a beam of monoenergetic potassium atoms is described. By measuring the attenuation of this beam on its passage through a plasma, electron densities may be evaluated. Since the beam velocity exceeds 10^7 cm sec^{-1} rapid changes in density may be observed. This technique has been applied to the plasma produced by a plasma gun, and compared with simultaneous microwave interferometer measurements. (auth)

23163 (IPP-3/47) DER DRUCKAUFBAU IN EINEM STATIONAEREN, MAGNETFELDSTABILISIERTEN HELIUMPLASMA HOHER DICHTE UND TEMPERATUR. (The Pressure Build-Up in a High-Density, High-Temperature Helium Plasma Stabilized by a Magnetic Field). Grassmann, P. H. (Institut fuer Plasmaphysik, G.m.b.H., Garching (West Germany)). Dec. 1966. 64p. (In German). Dep. mn.

Electron density, temperature, and pressure in a stationary helium plasma stabilized by a magnetic field were determined. By measuring the Faraday effect on plane polarized laser light it was found that the electron density has the value $n_e = 1.5 \times 10^{16}$ cm^{-3} constant over the radius. These measurements were used to determine the temperature from the continuum radiation intensity recorded in the visible spectral region. The axial temperatures measured were between 200,000 and 400,000°K, depending on the discharge current. The pressure profiles resulting from these measurements have steep gradients in the radial direction, which is proof that the confinement of the plasma by the magnetic field is good. The pressure profiles are discussed quantitatively. It is thereby shown that the pressure buildup in the plasma, besides being influenced by ambipolar diffusion, is mainly caused by the Nernst effect, already familiar in solid-state physics but hitherto disregarded in plasma physics. The theory of the Nernst effect also explains the measuring result that the electron density is constant over the radius. This is only valid for doubly ionized helium. (auth)

23164 (NP-16694) SPEKTROSKOPISCHE MESSUNGEN AN EINEM ELEKTRODENLOSEN PLASMABESCHLEUNIGER. (Spectroscopic Measurements on an Electrodeless Plasma Accelerator). Koehne, R. (Deutsche Versuchsanstalt fuer Luft- und Raumfahrt E. V., Porz (West Germany). Institut fuer Energiewandlung und Elektrische Antriebe). Aug. 1966. 25p. (In German). (DLR-FB-66-53). Dep. mn.

Spectroscopic measurements on a pulsed electrodeless plasma accelerator are reported. The purpose of these measurements is to estimate the loss of radiation energy within the visible range and to compare it with the applied electric energy. The conductivity is calculated from electron temperature and density. The energy loss of radiation was less than 1% of the electric energy. The conductivity of the He plasma was more than $10^2(\Omega\,m)^{-1}$. (auth)

23165 SATURATION LUMINANCE OF HIGH DENSITY MICROSECOND ARC CHANNELS. Fischer, Heinz; Michel, Lothar (Technische Hochschule, Darmstadt, Ger.). Appl. Opt., 6: 935-7(May 1967).

The emission of high current microsecond arc channels in argon and helium, with a 1-mm gap is studied by means of a 20-nsec exposure Kerr cell shutter, and profiles of the relative luminance B are determined from the photographic arc image. This method is largely unaffected by instabilities in the arc position; the scatter of relative luminance values was smaller than ±5%. Maximum values of the saturation luminance B^* in the axis of the arc channel are observed over a wide range of arc current which is altered by the gas pressure. A ratio of $B^*_{He}/B^*_A = 1.52$ for the two gases is determined. The luminance profile across the arc channel demonstrates increasing opacity after saturation is reached. (auth)

23166 SYNCHRONIZED HIGH SPEED SCANNING INFRARED SPECTROMETER. Camm, John C.; Taylor, Raymond L.; Lynch, Robert (Avco-Everett Lab., Everett, Mass.). Appl. Opt., 6: 885-91(May 1967).

A spectrometer which scans a wavelength band of 0.6 μ in 30 μsec and is useful from 2 to 6 μ is described. The instrument can be synchronized with a pulsed source with a minimum triggering delay of 15 μsec. The instrument is basically an Ebert spectrometer equipped with an indium antimonide detector at the exit slit, an aluminum scanning mirror placed 5 cm before the exit slit, and a wavelength calibration signal generator. The scanning mirror, which is supported on pivots inside a helical coil, deflects the spectrum through an angle of approximately 90° onto the exit slit. When a capacitor is discharged through the coil, the resulting magnetic field spins the aluminum mirror causing the spectrum to move across the exit slit. The wavelength calibration signal generator produces a series of electrical pulses as the scanning mirror turns, permitting wavelength calibration when the pulses are displayed below the spectrometer signal on a dual beam oscilloscope. Using this instrument on a shock tube, data have been obtained on the absolute spectral radiation intensity of air, nitrogen, neon, and argon heated by reflected shocks to equilibrium temperatures in the range of 6000 to 10,000°K. In this temperature region with these gases, an important source of continuum radiation is neutral Bremsstrahlung caused by the inelastic scattering of electrons from neutral atoms and molecules. By employing the scanning ir spectrometer it has been possible to separate the continuum radiation from contributions owing to lines and bands and determine the cross section for the neutral bremsstrahlung. (auth)

23167 STREAK SPECTROGRAPH WITH MICROSECOND RESOLUTION. Buttrey, D. E. (Lockheed Research Lab., Palo Alto, Calif.). Appl. Opt., 6: 881-3(May 1967).

An inexpensive, time-resolved spectrograph with microsecond time resolution has been simply constructed in the laboratory. A Gaertner glass-prism monochromator with a flat focal plane was combined with a Beckman–Whitley drum camera with the lens removed. The resulting combination has a geometric aperture of f/10 with a wavelength resolution of 1 Å at 4300 Å. The wavelength range of 3900 Å to 9000 Å can be covered with three settings of the wavelength drum on the monochromator. Examples of the spectral time history of reflected shocks in nitrogen and in oxygen for the conventional shock tube are given. This instrument has been particularly useful in recording Stark-broadened hydrogen lines and oxygen lines to measure the ion density in shock-heated gas samples. A continuum brightness of 4.3×10^7 ergs sec^{-1} cm^{-2} sr^{-1} $(10\text{ Å})^{-1}$ at 4300 Å is required to produce

a plate density of 0.3 on I–F film for optimum entrance slit width and 2.5-μsec exposure time. (auth)

23168 THEORETICAL PROPERTIES OF SPHEROIDALLY SYMMETRIC STATIC ARCS. Halder, A. K.; Whittaker, D. (Univ. of Liverpool). Brit. J. Appl. Phys., 18: 427–41(Apr. 1967).

A steady-state spheroidally symmetric discharge with losses solely by conduction is analyzed theoretically and its main properties are summarized in dimensionless form in a nomogram. Included as special cases are the unbounded arc, the cylindrical arc, and the filled-tube model. Radial variations are described by Legendre functions of complex degree. (auth)

23169 PHYSICS OF THE HIGH-FREQUENCY ELECTRODELESS DISCHARGE IN ARGON AT ATMOSPHERIC PRESSURE. Egorova, K. A. Zh. Prikl. Spektrosk., Akad. Nauk BSSR, 6: 288-91(Mar. 1967). (In Russian).

Electron density n_e, ionization temperature T_i, and "excitation" temperature T_b were determined in a plasma column of the hf electrodeless discharge obtained at the capacitance connection of the discharge tube with the counter of a generator possessing output power 1.5 kW. The values $n_e = 1.8 \pm 0.2 \times 10^{16}$ cm^{-3}, $T_i = 11{,}770 \pm 160$°K, $T_b = 11{,}000 \pm 500$°K coincide with the data for inductive discharges obtained with the use of generators of considerable powers (~10 kW). Similar results are accounted for by changing the geometric plasma sizes in consequence of which the specific power must not undergo considerable changes. (auth)

23170 PRODUCTION OF SPECTRA OF MULTIPLY CHARGED IONS BY FOCUSING LASER RADIATION ON A SOLID TARGET. Basov, N. G.; Boiko, V. A.; Voinov, Yu. P.; Kononov, E. Ya.; Mandel'shtam, S. L.; Sklizkov, G. V. (Lebedev Inst. of Physics, Moscow). JETP Lett. (USSR)(Engl. Transl.), 5: 141-3 (Mar. 15, 1967).

Translated from Zh. Eksp. Teor. Fiz., Pis'ma Redaktsiyu, 5: 177-80(Mar. 15, 1967).

The flash from a neodymium-glass laser was focused by a lens on aluminum and calcium targets placed in vacuum ~10^{-5} mm Hg. The plasma scattering was recorded by photographing its glow with a high-speed camera. The plasmoid radiation in the vacuum-ultraviolet region of the spectrum was registered with a DFS-6 spectrograph in a direction perpendicular to the laser beam. (M.O.W.)

23171 ENERGY DISTRIBUTION OF ELECTRONS IN THE POSITIVE COLUMN OF AN ARGON DISCHARGE. Kagan, Yu. M.; Milenin, V. M.; Mitrofanov, N. K. (Leningrad State Univ.). Zh. Tekh. Fiz., 36: 2219-20(Dec. 1966). (In Russian).

Electron distributions measurements in the positive column of an argon discharge in a 2.3-cm-diameter tube at pressures from 0.03 to 4.5 mm Hg and currents from 100 to 300 mA are presented. At low pressures the electron distributions were Maxwellian. At higher pressures there were more low-energy and fewer high-energy electrons than in the corresponding Maxwell distribution. At 3- and 4.5-mm Hg there were observed stable anomalous electron distributions exhibiting steps similar to the anomalous distributions reported previously. (ATD)

23172 EXCITATION OF A UHF OSCILLATION SPECTRUM BY FAST PRIMARY ELECTRONS IN FRONT OF THE CATHODE OF A Hg LOW PRESSURE DISCHARGE. Drost, H.; Behlke, H.; Schulz, G.; Pupke, H. Ann. Phys., 18: 398-404(1966). (In German).

The frequency spectra of the uhf plasma oscillations excited by collision of monoenergetic primary electrons in a low-pressure Hg discharge were measured. The frequencies were grouped in a width of approximately 800 MHz and the plasma frequency can be calculated by the Langmuir–Tonks formula. The oscillation amplitude was largest in the vicinity of the calculated plasma frequency and decreased to zero at the border of the spectrum. The number and intensity patterns of the discrete frequencies of the spectrum seem to be independent of the discharge parameters although their detection assumes, necessarily, the existence of a selective uhf measurement collector. With a simple balanced feeder or coaxial instrument lead and a crystal diode in the indicator circuit, only a single frequency can be detected which corresponds approximately to the Langmuir frequency. The origin of the spectrum was traced to a variation of the electron density. (tr-auth)

Kinetics of Plasma

Refer also to abstracts 23066, 23163, and 23224.

23173 (66-C-155) LANDAU DAMPING OF COUPLED OSCILLATORS. BenDaniel, D. J.; Hurwitz, H. Jr. (General Electric Co., Schenectady, N. Y. Research and Development Center). Apr. 21, 1966. 10p.

An analysis of the phenomenon related to Landau damping in a simple coupled oscillator model is presented. The relation of this damping to the Langevin equation and to equipartition of energy is illustrated. (auth)

23174 (66-C-219) ENHANCED SCREENING IN CLASSICAL BINARY COLLISIONS IN PLASMA. Terhune, J. H. (General Electric Co., Schenectady, N. Y. Research and Development Center). July 1966. 18p.

A correction to the exponential screening of the coulomb potential is derived for high-density, low-temperature plasmas composed of positive ions and electrons. The classical scattering angle is computed for several values of impact parameter and two values of ion impact energy both with and without the correction for a simple plasma of electrons and stationary ions. It is found that the correction enhances the screening, resulting in a generally smaller cross section for a given deflection angle. The magnitude of the effect is typically a few per cent in the cases discussed. (auth)

23175 (AD-637866) IONIZATION WAVES IN SEMICONDUCTORS AND GASEOUS PLASMAS. Report No. Scientific-4. Weissglas, Peter; Andersson, Bengt (Kungliga Tekniska Hogskolan, Stockholm (Sweden)). May 31, 1966. Contract AF 61(052)-888. 24p. (AFCRL-66-557). CFSTI.

A theory for ionization waves in plasmas is developed. If the ionization rate depends strongly on carrier temperature such waves may propagate and an instability which in some cases is absolute, can occur. The wave has a phase velocity opposite the electron drift and can have either positive or negative group velocity. The theory agrees qualitatively, but not in details with that previously developed by Pekarek for striations in gaseous discharges. In particular the theory is applied to InSb, which is a favourable solid state material for observations of ionization waves. Instabilities are predicted for bulk p-type and thin layers of intrinsic material. The possibility of a new kind of negative resistance instability in semiconductors is pointed out. (auth)

23176 (AD-637868) EXPERIMENTS ON NONLINEAR PLASMA WAVE INTERACTION. Report No. Scientific-7. Kerzar, Boris; Weissglas, Peter (Kungliga Tekniska Hogskolan, Stockholm (Sweden)). May 31, 1966. Contract AF 61(052)-888. 19p. (AFCRL-66-559). CFSTI.

Non-linear interaction between waves on a low pressure mercury vapor discharge surrounded by a cylindrical wave guide was studied. The waves which were considered are all azimuthally symmetric. By proper choice of propagation direction and frequency of the primarily generated waves it was possible to generate both slow and fast waves by means of the non-linear interaction. (auth)

23177 (AD-637949) PARAMETRIC COUPLING BETWEEN ION AND ELECTRON WAVES. Report No. Scientific-6. Sjolund, A.; Stenflo, L. (Kungliga Tekniska Hogskolan, Stockholm (Sweden)). May 31, 1966. Contract AF 61(052)-888. 13p. (AFCRL-66-558). CFSTI.

Parametric coupling between ion and electron waves is studied by means of coupled mode theory. The coupling coefficients are determined. A numerical example is given and the gain is calculated. (auth)

23178 (AD-644695) STUDIES OF BEAM–PLASMA INTERACTIONS IN A MAGNETIC FIELD. Apel, J. R. (Johns Hopkins Univ., Silver Spring, Md. Applied Physics Lab.). June 1966. Contract NOw-62-0604. 132p. (TG-821). CFSTI $3.00 cy, $0.65 mn.

The interactions between a warm plasma and an electron beam, both immersed in a uniform magnetic field, were investigated theoretically and experimentally. The theoretical problem considered was that of growing waves in a cylindrical beam and plasma of equal radii propagating in a half-space $z > 0$, and surrounded by a perfectly conducting cylinder having either radius a or infinity. Implicit dispersion equations yielding k = k (omega) are given which incorporate many of the important facets of a laboratory plasma, and solutions are obtained for certain cases. Experiments were performed with an electron beam and a plasma whose properties and geometrical configuration were as close to those of the theoretical model as practicable. The interaction that leads to the growing wave is shown to arise from the coupling of the electron-cyclotron wave in the plasma and the Doppler-shifted electron-space-charge wave in the beam. Approximately 10% of the beam power was converted into oscillatory power by the time the wave growth had reached a nonlinear limit. (auth)

23179 (ARL-66-0182) EXPERIMENTAL INVESTIGATION OF THE CONDUCTION OF ELECTRIC CURRENT BETWEEN COLD ELECTRODES IN SHOCK-IONIZED AIR PLASMAS. Hoppmann, Roger F. (Rensselaer Polytechnic Inst., Troy, N. Y.). Sept. 1966. Contract AF 33(615)-1080. 79p.

The conduction of electric current between cold electrodes in a high-velocity shock-ionized air plasma has been studied experimentally in order to investigate the conduction mechanisms involved. Current–voltage characteristics were measured in the ionized test flow behind the incident shock wave in an arc-driven shock tube. The electrode configuration employed in the experiments was of a shielded type and applied voltages of from 1.5 to approximately 100 volts were used to drive the electrode currents. Data were obtained at shock Mach numbers between 17.5 and 18.6 with an initial pressure of 1 mm Hg in the driven section. The degree of ionization of the test flow was approximately 6×10^{-4}. The experimental data for the lowest range of electrode potentials are compared with the results of a recent theoretical analysis and the agreement is shown to be satisfactory. In the intermediate range of electrode potentials, a mechanism based on a simple ionic resistor model is proposed, to provide a possible explanation of the experimental data. For the highest range of electrode potentials employed, the current approached a limiting value which is probably determined by the convection of ions into the boundary layer from the inviscid free stream. In all ranges of electrode potential employed in the present research, the cathode boundary layer is found to play a dominant role in controlling the flow of current. Electrical breakdown was observed in some cases when high electrode voltages were employed. When breakdown occurs, the cathode current becomes extremely nonuniform, with the average cathode current density being more than an order of magnitude greater than the local value measured at the center of the cathode surface. The anode current, on the other hand, remains fairly uniform over the electrode surface. (auth)

23180 (IAE–1085) REKOMBINATSIYA POLOZHITEL'NYKH IONOV V PLAZME. (Recombination of Positive Ions Within Plasmas). Smirnov, B. M. (Gosudarstvennyi Komitet po Ispol'zovaniyu Atomnoi Energii SSSR, Moscow. Institut Atomnoi Energii). 1966. 56p. (In Russian). Dep. mn.

The author surveys the theoretical aspects and experimental data on recombination of positive ions and electrons or negative ions within plasmas on the basis of 125 references. The discussion of triple and collision-radiation recombinations is followed by a description of the recombination of ionized atoms, and electrons through the formation of a self-ionization state, the recombination with the participation of negative ions, the recombination of ionized molecules, and the transitions between atomic and molecular levels. Data on recombination coefficients reported by various researchers are compared in comprehensive tables. (JPRS)

23181 (N–67–14817) DISPERSION RELATIONS FOR A MAGNETOACTIVE FINITE TEMPERATURE PLASMA. Hsieh, H. C. (Michigan Univ., Ann Arbor. Electron Physics Lab.). Sept. 1966. 65p. (NASA-CR–80914; TR–95). CFSTI $3.00 cy, $0.65 mn.

The dispersion relation for a finite-temperature magnetoactive plasma is derived in a form particularly suitable for the study of the effects of transverse static electric and magnetic fields upon the coupling between the transverse and longitudinal modes. The derivation is based on the coupled Boltzmann–Vlasov–Maxwell equations under the one-dimensional small signal assumptions. The time-varying parts of the particle distribution functions for a two-component plasma are divided into three parts; namely, those associated respectively with the right-hand and left-hand circularly polarized transverse waves and that associated with the longitudinal mode. The mode coupling equation, which relates the dynamic electric fields of these modes, is derived in terms of the time-independent part of the distribution function for two cases: longitudinal propagation in the presence of a transverse static electric field, and oblique propagation in the absence of static electric field. If the time-independent portions of the distribution functions are taken to be Maxwellian, it is shown that in the low-temperature limit the dispersion relationship reduces to the familiar expression for the cold plasma. Possible applications of the derived dispersion relationship are briefly discussed. (auth)

23182 (N–67–15299) NONLINEAR ELECTROMAGNETIC WAVE PROPAGATION IN A MAGNETOACTIVE FINITE TEMPERATURE PLASMA. Hsieh, H. C.; Rowe, J. E. (Michigan Univ., Ann Arbor. Electron Physics Lab.). Sept. 1966. 55p. (NASA-CR–81149; TR–94). CFSTI $3.00 cy, $0.65 mn.

A system of ordinary nonlinear differential equations, governing the scalar and vector potentials associated with a one-dimensional electromagnetic wave in a hot plasma, has been derived using a stationary solution of the nonlinear Boltzmann–Vlasov equation in a moving reference frame. Three cases are considered: no applied static electromagnetic field, a static magnetic field in the direction of wave propagation, and static electric and magnetic fields in the direction of propagation. In the static-field-free case, the derived dispersion relation indicates that the wavelength of the transverse electromagnetic wave is amplitude-dependent. In the second case, the transverse electromagnetic wave appears as a circularly polarized sinusoidal wave in a laboratory frame of reference. In the third case, the transverse electromagnetic wave appears as an elliptically polarized plane wave in the laboratory frame. The effect of the static electric field on the wavelength and the Faraday rotation is investigated. (auth)

23183 (NP-tr–1527) DESTRUCTION OF WAVE FRONT OF STRAIGHT MAGNETO-ACOUSTIC WAVES AT LARGE MACH NUMBERS. Zagorodnikov, S. P.; Smolkin, G. E.; Sholin, G. V. (Gosudarstvennyi Komitet po Ispol'zovaniyu Atomnoi Energii SSSR, Moscow. Institut Atomnoi Energii). Translated for Culham Lab., Eng., from report IAE–1263. 17p. (CTO–356). Dep. mn. CFSTI $3.00 cy, $0.65 mn. JCL $1.60 fs, $0.80 mf.

Experimental investigations of straight cylindrical magneto-acoustic waves of large amplitude propagating in a tenuous plasma are described. At relatively small magnetic Mach numbers ($M < M_{crit}$) waves with steep fronts are observed of duration equal to 11 periods of oscillation at the mean geometrical frequency. For $M > M_{crit}$, along the initial path section a wave is formed with a steep front, of duration τ_e and width δ_e; a rapid increase of these parameters by approximately an order of magnitude is then observed in the central region of the plasma column. The effect is interpreted as destruction of the magnetoacoustic waves by counterstreaming ion fluxes and the excitation of the ion–ion two-stream instability at Mach numbers $M > M_{crit}$. (auth)

23184 DISTRIBUTION OF PLASMA PARAMETERS IN POSITIVE COLUMN WITH NONHOMOGENEOUS HF FIELD. Grigorov, G.; Popov, G.; Drazheva, L. (Sofia Univ.). Compt. Rend. Acad. Bulg. Sci., 18: 307-10(1965).

A glow discharge was produced in dry air at a pressure of 0.3 torr. A nonhomogeneous hf field was obtained with two thin rings to which voltage is applied from a generator by means of a tuned circuit. The plasma parameters are determined by means of a mobile Langmuir probe located in the plane of symmetry between the two rings. (M.O.W.)

23185 RADIATION FROM NONLINEARLY EXCITED PLASMAS. Cheng, H. (Massachusetts Inst. of Tech., Cambridge); Lee, Y. C. Phys. Rev., 156: 172-7(Apr. 5, 1967).

Longitudinal plasma oscillations can be excited nonlinearly by two strong incident electromagnetic waves. The reradiation from such nonlinearly excited plasma is calculated for the cases of a thin plasma film and a small plasma column. Finite-temperature effects are neglected, but the dominant mechanism of coupling between longitudinal and transverse waves by boundaries is properly taken into account. Resonances in such reradiation from both the thin film and the small column are found at frequencies ω_p and $\omega_p/\sqrt{2}$, respectively, where ω_p is the plasma frequency. The intensity of such reradiation is compared with the scattered intensity of another electromagnetic wave from the same nonlinearly excited plasma. It is found quite generally that the reradiation dominates the scattering, thereby explaining the result of a recent experiment. (auth)

23186 CYCLOTRON ECHOES IN PLASMAS. Herrmann, G. F.; Hill, R. M.; Kaplan, D. E. (Lockheed Palo Alto Research Lab., Calif.). Phys. Rev., 156: 118-33(Apr. 5, 1967).

Experimental observations of cyclotron echo phenomena in rare-gas and nitrogen afterglow plasmas in the presence of a slightly inhomogeneous magnetic field are presented. The formation of cyclotron echoes is treated theoretically, and specialized to the case of a velocity-dependent collision frequency mechanism, which seems to best explain the experimental observations. Detailed calculations for this case, including such factors as echo amplitude, echo lifetime, and the form of echo decay envelopes, are made and related to the present experimental results. Comparison is made with other mechanisms of cyclotron echo formation. In addition, a detailed discussion of the effects on two-pulse and three-pulse echo amplitude due to electron diffusion into regions of inhomogeneous magnetic field is included. (auth)

23187 COLLISION FREQUENCY IN AIR WITH CROSSED ELECTRIC AND MAGNETIC FIELDS. Bhiday, M. R.; Paithankar, A. S.; Sharda, B. L. (Govindram Seksaria Technological Inst., Indore, India). Brit. J. Appl. Phys., 18: 241-52(Feb. 1967).

Pre-breakdown ionization measurements of $(\alpha/p)_{H/p,E/p}$ (Townsend coefficient) in air in crossed electric and magnetic fields support the equivalent pressure concept if it is assumed that the collision frequency ν increases with E/p and an unrestricted $E \times H$ drift of electrons is ensured as in a cylindrical geometry. (auth)

23188 NONLINEAR EFFECTS IN A PLASMA. Tsytovich, V. N. (Lebedev Inst. of Physics, Moscow). Usp. Fiz. Nauk, 90: 435-89(Nov. 1966). (In Russian).

Nonlinear effects in a plasma are reviewed with emphasis on the nonlinear interaction between waves having random phases in a plasma. The nonlinearity is assumed weak, and the energy of the interacting waves is assumed to be much larger than the energy of the equilibrium fluctuations in the plasma. The introductory section includes nonlinear effects and plasma physics and problems in the procedure of calculating nonlinear effects. The general theory of the interaction of waves in spatially dispersive media is discussed including the concept of the number of waves — the connection between the spontaneous and induced processes; the processes of radiation, scattering, and decay; the kinetic equation for waves; nonlinear plasma current and probability of decay processes; and nonlinear and Compton scattering and their interference. The topics covered under nonlinear interaction of waves in an isotropic plasma are: stimulated scattering of Langmuir waves with transformation into Langmuir waves on the plasma electrons, nonlinear scattering via virtual transverse waves, induced scattering of ion-sound waves, induced scattering of Langmuir waves by ions, nonlinear interaction of Langmuir and ion-sound waves, nonlinear interaction of transverse waves, nonlinear interaction of transverse and Langmuir waves, and nonlinear interaction of transverse and ion-sound waves. Some unsolved problems in the theory of nonlinear interaction are mentioned in conclusion. 105 references are included. (TSS)

23189 ULTRAHIGH-FREQUENCY INTENSITY-MODULATED LIGHT FROM A PLASMA. Morris, Glen J. (Boeing Scientific Research Labs., Seattle). Phys. Rev. Lett., 18: 734-6(May 1, 1967).

Observations of intensity-modulated light emanating from a plasma in which the two-stream instability was used to excite coherent longitudinal oscillations were made in the plasma-oscillation frequency range from 300 to 500 Mc. A photomultiplier radiometer, which was essentially a short-time-resolution photomultiplier coupled to a radio receiver, was used to make the observations. Two contra-streaming coaxial electron beams were used to generate a plasma and to excite longitudinal plasma electron oscillations in it. It was concluded that intensity modulation of the emitted light should occur at 700 ± 10 and at ~150 Mc. (A.G.W.)

23190 PROPAGATOR FOR DISTURBANCES IN A PLASMA. Nozawa, Reikichi (EURATOM-CNEN, Rome). J. Nucl. Sci. Technol. (Tokyo), 3: 539-48(Dec. 1966).

The propagation of high-frequency disturbances in an infinite plasma is studied by the method of propagators. The plasma is assumed to be an electron fluid with positive uniform background. The propagator is given explicitly in terms of generalized functions. It possesses a characteristic rear wake behind the head of the wave, attributable to dispersion within the plasma. (auth)

23191 STATIONARY DISTRIBUTION OF A PLASMA IN THE FIELD OF A STRONG ELECTROMAGNETIC WAVE. Kotsarenko, N. Ya.; Fedorchenko, A. M. (Kiev State Univ.). Zh. Tekh. Fiz., 36: 2107-10(Dec. 1966). (In Russian).

A problem on stationary self-consistent plasma density distribution in a stationary electromagnetic wave field was previously resolved in a hydrodynamic approximation. An attempt is made here to resolve a similar problem without considering the gas dynamic pressures. The other assumptions and methods are identical to the previous work of T. F. Volkov (Plasma Physics and Problems of Controlled Thermonuclear Reactions, Vol. 3, p. 336, Izdatel'stvo "Nauka", (1958)). (R.V.J.)

23192 NONLINEAR GENERATION OF COMBINATION FREQUENCIES IN A HOMOGENEOUS MAGNETOPLASMA. Mittal, R. S. (Univ. of Delhi); Kaw, P. K. Can. J. Phys., 45: 1587-95(Apr. 1967).

Explicit expressions were derived for the combination frequency components of the current density in a homogeneous magnetoplasma due to two alternating electric fields. While deriving these expressions, all the important contributions arising from the various isotropic and anisotropic parts of the distribution function were taken into account. An interesting result is that, in the general case, when the applied electric fields are in the form of pure modes of two fundamental waves, only the opposite modes of the combination frequency components are generated in the current density. Some numerical results depicting the phenomenon of resonances for some simple interesting situations are presented. (auth)

23193 DYNAMICS OF WEAKLY IONIZED GASES. De Barbieri, O.; Maroli, C. (Univ., Milan). Ann. Phys. (N. Y.), 42: 315-33(Apr. 1967).

Starting from the Liouville equation and utilizing the multiple time-scale method, the equations are derived which govern the dynamics of a many-species plasma in presence of neutrals and with an arbitrary ionization ratio. The plasma is supposed to be in equilibrium and the collisions between neutral and charged particles are taken to be elastic; thus the temperature of the plasma is quite low, of the order of a few eV. The importance of a parameter $\mu(\mu \simeq \nu_{e,M}/\omega_p)$ is emphasized, where $\nu_{e,M}$ is the electron–neutral-molecule elastic collision frequency and where ω_p is the electron plasma frequency, such that for $\mu \gg 1$ the equations become those of the Lorentz plasma, while for $\mu \ll 1$ one has the case of a fully ionized plasma. The domain of applicability of these limiting equations is discussed. (auth)

23194 AMPLIFICATION OF RADIATION DURING THE DECAY OF HIGHLY IONIZED PLASMA. Gordiets, B. F.; Gudzenko, L. I.; Shelepin, L. A. (Lebedev Inst. of Physics, Moscow). Zh. Prikl. Mekh. Tekh. Fiz., No. 5, 115-17(Sept.-Oct. 1966). (In Russian).

An investigation was made of the possibility of amplifying electromagnetic radiation at frequencies of the atomic spectrum in plasma undergoing pulse recombination. Since the rapid decay of plasma causes an inversion in level population, it is simpler to analyze the population distribution over discrete levels in ions of decaying plasma in which the majority of heavy particles are bare atomic nuclei of one of the elements (H^+, He^{++}, Li^{++}, etc.). In addition to investigating the relaxation of hydrogen-like ions, an analysis is also made of the population in atoms of alkali metals or alkali-like ions during the decay of their plasma. Numerical data are used in an evaluation of the amplifying properties of the decaying plasma of a chemical element with the atomic number Z. It is shown that at comparatively high densities of free electrons there is a region of optimum temperatures at which the absolute inversion acquires the maximum value. (ATD)

23195 IONIZATION RATES IN THE INERT GASES. Burkley, C. J.; Sexton, M. C. (Univ. Coll., Cork, Ireland). Brit. J. Appl. Phys., 18: 443-5(Apr. 1967).

A microwave technique has been used to determine the ionization rate α (defined as the number of electron–ion pairs produced by an electron per second) in helium, argon, and xenon plasmas. Close agreement has been obtained with ionization rates calculated from the free-fall and diffusion theories. (auth)

23196 DISPERSION OF THE WHISTLER MODE FOR A VELOCITY DISTRIBUTION WITH A LOSS CONE. Das, A. C. (Imperial Coll. of Science and Tech., London). J. Plasma Phys., Pt. 1, 1: 29-36(Feb. 1967).

Considering the general dispersion equation for the whistler mode, the condition of critical stability is discussed and the values of k^2 and the field strength for critical stability are determined. The waves grow due to resonance; the stability criterion is studied and the growth rate is also calculated. The results for a special case of simple velocity distribution with a loss cone are obtained and compared with those due to cold dispersion. In the magnetosphere the thermal electrons, which can be treated as cold, should be included in the distribution and this is discussed. Finally, the regions of stable and unstable plasma were established for the special velocity distribution function, and it can be seen how these depend on the size of loss cone. (auth)

23197 NONLINEAR CONSTANT-PROFILE PLANE WAVES IN A COLD PLASMA UNDER AN APPLIED MAGNETIC FIELD. Alloucherie, Yves J. (Goddard Space Flight Center, Greenbelt, Md. Univ. of Maryland, College Park). J. Plasma Phys., Pt. 1, 1: 55-74(Feb. 1967).

Periodic plane waves propagating in a homogeneous cold Vlasov plasma under the influence of an external magnetic field B_0 have been studied. Nonlinear coupled differential equations for the two transverse components of the local magnetic field have been obtained for any angle α between B_0 and the wave vector. Starting from the previously obtained exact solution for $\alpha = 90°$ and the zeroth-order solution for $\alpha = 0$, two perturbation methods are used to obtain first-order solutions for $\alpha = 0$ and intermediate angles. A numerical example has been worked out in detail for a specific value of the field energy density; although it is not possible to match the two sets of results rigorously, they seem to converge smoothly to the same limit. (auth)

23198 RESONANT PARTICLE INSTABILITIES IN A UNIFORM MAGNETIC FIELD. Kennel, C. F.; Wong, H. V. (IAEA, Trieste, Italy). J. Plasma Phys., Pt. 1, 1: 75-80(Feb. 1967).

A simple expression is presented for the resonant particle growth rate of arbitrary plasma waves propagating at an arbitrary angle to a uniform magnetic field in a spatially homogeneous plasma. It is then shown that cyclotron harmonic wave-particle resonances contribute to instability when the resonant particle pitch angle distributions are anisotropic, while the phase velocity resonances of the Landau form are unstable to beam type phenomena. A sufficient condition for resonant particle stability is that particle distributions be isotropic and monotonically decreasing with increasing energy everywhere. (auth)

23199 SCATTERING OF WAVES IN A PLASMA IN THE PRESENCE OF CONVERSION. Piliya, A. D. (Ioffe Inst. of Physics and Tech., Leningrad). Zh. Tekh. Fiz., 36: 2195-9 (Dec. 1966). (In Russian).

Scattering with change of frequency of electromagnetic waves in an inhomogeneous plasma is discussed. The scattering is treated as due to induced currents proportional to the product of the electric field of the incident wave and the electron density fluctuations in the plasma. An expression is derived for the scattering coefficient as an integral involving the Fourier space component of the correlation function of the Fourier time components of the electron density fluctuations and other quantities. The behavior of this expression is discussed under the condition that a certain quantity be small. It is found that conversion leads to a large increase in the spectral density and to a considerable broadening of the spectrum. The scattering depends on the ratio of the electron temperature to the ion temperature, and in principle this ratio can be determined by comparing theoretical curves with experimental curves. (ATD)

23200 KINEMATICS OF THE CURRENT-CARRYING LAYER IN A PLASMA ACCELERATOR. Baranov, V. Yu.; Musin, A. K.; Timofeeva, G. G. Zh. Prikl. Mekh. Tekh. Fiz., No. 5, 107-12 (Sept.-Oct. 1966). (In Russian).

The results of analytical and experimental investigations of the dependence of kinematic characteristics of quasi-neutral bunches of charged particles in rail-type accelerators on the electrical and geometric parameters of the accelerating circuit are compared. The movement of a plasma bunch along the electrodes as a function of their erosion is described by an equation that can be approximately solved by an asymptotic method applicable to nonlinear oscillations with strong attenuation. The magnitudes characterizing the process of acceleration can then be numerically determined and their behavior qualitatively described. The main features of the rail-type plasma accelerator used for experimental investigations of the kinematics of bunches are diagrammatically shown. Two parallel copper bars 2.5 cm wide, 0.15 cm thick, and 37 cm long served as guiding electrodes (rails). The distance between them could be varied between 0.5 and 5.5 cm. The plasma source was the discharge current from a 50 to 300 μF condenser at 0.5 to 7 kV between the rails, initiated by the breakdown of a shot of gas introduced between the rails. The pressure of residual gases in the accelerator did not exceed 10^{-4} mm Hg. The velocity of the bunches was determined by double probes between the guiding rails. The momentum of the bunches was measured by ballistic pendulums suspended at the end of the track. The measurement results show the interrelationship of the characteristic parameters along with the analytical data. (ATD)

23201 SOME CONDITIONS FOR THE EXISTENCE OF A PINCH STRUCTURE IN THE SKIN LAYER OF A PLASMA. Grigor'ev, V. N. Zh. Prikl. Mekh. Tekh. Fiz., No. 5, 58-63 (Sept.-Oct. 1966). (In Russian).

Multichannel discharges in plasma accelerators are studied theoretically using a longitudinal pinch as a model. The applicability of the model is discussed giving numerous references to experimental observations. It is assumed that pinch current is carried by narrow channels with infinite conductivity. The existence of pinch structure is shown to be confined by limits obtained from pressure balance, provided that plasma deceleration by magnetic field exceeds greatly viscous forces. As the initial gas pressure decreases, plasma deceleration time decreases and the characteristic ionization and excitation times increase. It is shown that in such accelerators, induced currents have a stabilizing role. The decay of the pinch is a result of the decreasing current from the pulse generators while pinches are moving through the plasma, as is the case usually in theta and linear pinches. The experimental data of several authors are reviewed in the light of the above discussion and is shown to support the conclusions of this work. (ATD)

23202 POTENTIAL EQUATIONS FOR ANISOTROPIC INHOMOGENEOUS MEDIA. Chawla, B. R.; Rao, S. S.; Unz, H. (Univ. of Kansas, Lawrence). Proc. IEEE (Inst. Elec. Electron. Eng.), 55: 421-2(Mar. 1967).

Electromagnetic-wave problems in anisotropic and inhomogeneous media can be solved by defining scalar and vector potentials. By means of a relation between the scalar and the vector potentials different from the one used by Nisbet, a simpler vector potential wave equation is obtained. Polarizable and magnetizable types of media are considered. (auth)

23203 HIGH-FREQUENCY PLASMA OSCILLATIONS IN JUNCTION-TYPE DIODES. Gordeev, G. V. Zh. Prikl. Mekh. Tekh. Fiz., No. 5, 50-7(Sept.-Oct. 1966). (In Russian).

The longitudinal high-frequency plasma oscillations in junction-type diodes were investigated by the method of kinetic equations. The asymmetry of the boundary conditions at the plasma interface with the electrode barriers was taken into account. In the plasma of a glow or arc discharge, as well as in semiconductor diodes, when the current passes through the diode, the conditions on the boundaries between plasma and space-charge regions are not identical. Under direct current in a p-i-n diode holes are reflected from the boundary separating the i and p regions and easily penetrate into the n region, where they recombine; the electrons, however, easily penetrate into the p region, where they recombine and are reflected from the boundary separating the i region from the n region. A similar asymmetry of boundary conditions takes place on boundaries of a positive column with electrode barriers in glow and arc discharges as well as in the plasma of the cesium diode. It is shown that when the time required for the wave to travel the distance between the electrodes is half of the damping time of the wave in an unbounded plasma, a continuous wave may appear as the result of the superposition of the waves reflected from the electrodes over the perturbation wave. (ATD)

23204 SHORT HYDROGEN PLASMOIDS. Gol'ts, E. Ya. Zh. Prikl. Mekh. Tekh. Fiz., No. 5, 113-15(Sept.-Oct. 1966). (In Russian).

A method for production of hydrogen plasmoids of 5 to 15 cm length with densities varying from 10^{10} to 5×10^{11} cm^{-3} is described. This method utilizes decimeter waves for plasma acceleration with electric field cutoff to shorten plasma length and a set of diaphragms for limitation of the radial extent of the plasma. Static electric fields applied to grids in the plasma path were also used to stop the flow of high- and low-density plasma. The plasma generators, accelerating sections, and cutoff grids are described, including dimensions, materials, and optimum operating conditions. The experimental results are presented and their interpretation is discussed. This work shows that production of relatively pure hydrogen plasmoids of small dimensions is possible for densities as high as 10^{12} cm^{-3}. (ATD)

23205 PLANAR EXPLOSION IN ELECTRICALLY CONDUCTING GAS IN SLOPING MAGNETIC FIELD. Korobeinikov, V. P. (Mathematics Inst., Moscow). Dokl. Akad. Nauk SSSR, 171: 545-8(Nov. 21, 1966). (In Russian).

The problem of a planar explosion in an ideally conducting gas is analyzed. In this case the intensity vector of the initial field is of arbitrary intensity and is directed at some angle to the plane of the explosion. The problem is described by flow equations and energy equations, and several methods of solution are discussed. (TSS)

23206 MEASUREMENT OF THE ELECTRIC CONDUCTIVITY OF SHOCK-IONIZED AIR. Valentin, Pierre; Cottereau, Marie-Joseph (Faculte des Sciences de Rouen, Seine-Maritime, France). Compt. Rend., Ser. B, 264: 130-3(Jan. 9, 1967). (In French).

The simple four-electrode device used for the measurement is described. Results agree well with those of Lamb and Lin (J. Appl. Phys., 28: 754(1957)), obtained by means of a magnetic method. (J.S.R.)

23207 COLLISIONAL DAMPING OF THE WHISTLER MODE IN A DENSE PLASMA. Watanabe, Hiroshige; Sugita, Keiichiro; Nagao, Shigeo (Tohoku Univ., Sendai). Jap. J. Appl. Phys., 6: 634-44(May 1967).

The effect of Coulomb collisions on the transverse wave along an external magnetic field in a fully ionized dense plasma is investigated by means of the Fokker-Planck equation. Expressions for the dispersion relation and the spatial damping constants of the whistler mode are obtained. The spatial damping constants, to first order, are given by

$$\kappa_i = \frac{2}{3\sqrt{\pi}} \cdot \left(\frac{k\nu_c}{\omega_c - \omega}\right) \cdot \left[1 + \frac{7}{5}\left(\frac{kv_0}{\omega - \omega_c}\right)^2\right], \quad \kappa_e = \frac{14}{15\sqrt{2\pi}} \cdot \left(\frac{k\nu_c}{\omega_c - \omega}\right)\left(\frac{kv_0}{\omega - \omega_c}\right)^2,$$

where ν_c is the electron collision frequency, v_0 is the electron thermal velocity, k is the wave number and ω_c is the electron cyclotron frequency. Finally, their applications to the experimental results are briefly discussed. (auth)

23208 INTERACTION BETWEEN A SPATIALLY SEPARATED BEAM AND PLASMA. Sinitsa, N. G. Zh. Tekh. Fiz., 36: 2111-17(Dec. 1966). (In Russian).

An investigation was made of the interaction of cold and homogeneous beams of charged particles and plasma separated by a dielectric insulator of finite thickness. The problem is solved in the linear hydrodynamic approximation without taking into account the constant magnetic field and dissipative processes. When a beam of charged particles penetrates a plasma, high-frequency oscillations are generated of the order of the electron

plasma frequency if the plasma density is high, or of the order of the electron cyclotron frequency if the plasma density is low. To weaken this interaction, the beam and plasma must be separated by an insulator of finite thickness. A coaxial system infinite in the longitudinal direction is investigated in which a beam with a radius r_1 passes inside a dielectric pipe with a thickness $r_2 - r_1$; the plasma is between the dielectric pipe and an ideally conducting casing with an inner radius $r_3 > r_2$. The interaction of the beam and plasma is described with the aid of Maxwell hydrodynamic equations. It is shown that the buildup increment of oscillations with a wavelength smaller than the thickness of the insulator is exponentially small in comparison with the increments in the case when the beam passes directly through the plasma. Such a geometry can be used in cases when it is necessary to weaken the binding between the plasma and the beam at high frequencies without decreasing the buildup increments of the low-frequency oscillations. (ATD)

23209 X RADIATION AT THE ELECTRON CYCLOTRON RESONANCE IN A MAGNETIC TRAP. Piliya, A. D.; Frenkel', V. Ya. (Ioffe Inst. of Physics and Tech., Leningrad). Zh. Tekh. Fiz., 36: 2190-4(Dec. 1966). (In Russian).

The intensity of x rays due to the electrons of a plasma confined in a magnetic trap striking the wall of the chamber during heating of the plasma by a high-frequency field at the electron cyclotron frequency is calculated. The calculation is based on a differential equation for the electron velocity distribution function derived elsewhere. This differential equation is integrated under the appropriate boundary conditions with the aid of some simplifying assumptions, and there is derived an approximate expression for the x-ray intensity as a function of the time since the high-frequency field was turned on. For a plasma of finite thickness (or with a finite penetration depth of the high-frequency field), the x-ray intensity passes through a maximum as a function of time, owing to depletion of the plasma of electrons. For an infinitely thick plasma this maximum is masked as a result of the strong dependence of the x-ray intensity on the electron velocity. The theoretical curve is compared with an experimental curve of x-ray intensity versus time, and qualitative agreement is shown. (ATD)

23210 KINETIC EQUATIONS OF GASES AND PLASMAS. Wu, Ta-you. Addison-Wesley Series in Advanced Physics. Reading, Mass., Addison-Wesley Publishing Co., Inc., 1966. 304p. $12.50.

Some basic aspects of the theory of irreversible processes in gases and some of the recent developments in the formulation of the kinetic equation of plasmas are presented. The Boltzmann theory and the more recent theories of Bogoliubov, Frieman, Sandri, Rosenbluth, Rostoker, Prigogine Balescu, and others are covered. Theories are presented in a more or less historical order. Emphasis is on those theories which start from the Liouville equation. Basic ideas of macroscopically irreversible processes are stressed, along with the assumptions of the various theories and the interrelations between them. (M.H.R.)

Production of Plasma

Refer also to abstract 22215.

23211 (AD-643197) PLASMA PROPERTIES OF KILOAMPERE DISCHARGES. Creedon, John E. (Army Electronics Command, Fort Monmouth, N. J.). Nov. 1966. 65p. (ECOM-2773). CFSTI $3.00 cy, $0.65 mn.

Plasma properties and characteristics of interest to high-current switching devices were investigated. Peak pulse currents up to 80,000 amperes were used to generate dense plasmas in linear glass-metal diodes. Two tube diameters, 3 and 7.5 inches, were studied. In the case of the 3-inch-diameter diode, the electrode separation was varied from 10.6 to 25.1 cm. Hydrogen gas was studied in the pressure range from 0.5 to 40 torr. Electron densities and temperatures have been determined using spectroscopic techniques. Densities were found to be in the 10^{16} to 10^{17} cm^{-3} range. Plasma resistivities have been determined from a knowledge of the density and temperature. The observed dependence of resistivity on current and pressure is discussed and the results are compared with resistivities obtained from tube-drop measurements. The effects of impurities and instabilities are discussed. (auth)

23212 (CEA-Bib-88) LES ARCS A CATHODE CREUSE. Mise au Point Bibliographique. (Hollow-Cathode Arcs. Literature Survey). Breton, Claude (Commissariat a l'Energie Atomique, Fontenay-aux-Roses (France). Centre d'Etudes Nucleaires). Mar. 1967. 28p. (In French). Dep. mn.

Arc discharges have been studied for a large number of years in a wide range of operational conditions. The idea of using hollow electrodes, a magnetic field and a constant axial gas-stream appears to have resulted from work carried out at Oak Ridge in about 1955. Since then, hollow cathode or anode arcs have been further developed. Phenomena connected with the cathode have, however, been little studied. The object of this work is to review this particular field of a type of arc having remarkable properties. (auth)

23213 (CEA-R-3113) IONISATION D'UN ATOME DE CESIUM PAR UN PROCESSUS D'ABSORPTION A DEUX PHOTONS ISSUS D'UN FAISCEAU LASER. (Ionization of a Cesium Atom by an Absorption Process Involving Two Photons From a Laser Beam). Gontier, Yves; Trahin, Michel (Commissariat a l'Energie Atomique, Saclay (France). Centre d'Etudes Nucleaires). Jan. 1967. 35p. (In French). Dep. mn.

The expression giving the ionization cross section of an atom, by an absorption process involving two photons produced from a laser beam, is derived. The nonrelativistic case is considered and the dipolar approximation used. The summation over the intermediate states is carried out rigorously by means of a special technique which is described in detail. A method is presented which makes it possible to obtain the numerical solution. (auth)

23214 (NP-16669) EKSPERIMENTY S SIL'NOTOCHNOI IMPUL'SNOI DUGOI. (Experiments with a High-Current Pulsed Arc). Alikhanov, S. G.; Konkashbaev, I. K.; Estrin, B. S. (Akademiya Nauk SSSR, Novosibirsk. Institut Yadernoi Fiziki). 1966. 18p. (In Russian). Dep. mn.

A pulsed, high-current arc in hydrogen has been investigated experimentally yielding data on a high-temperature dense plasma. The discharge tube, the measurement of plasma conductivity, the arrangement of the appropriate magnetic fields, the determination (by piezoelectric sensor) of the gas kinetic pressure of the plasma, and the photographic and spectrographic registration of the data are described. A semitheoretical processing of data shows that, following an unstable starting period, the discharge becomes stable and is characterized by a large amount of impurities. During the current maximum, half of the gas kinetic plasma pressure is due to the pinch effect. The plasma had a density of $n_i \simeq 10^{18}$ cm^{-3} for a T_{max} of $\sim 2 \times 10^5$°K. The course of the energy decay seems to indicate that the radiation is highly absorbed by multiply charged impurity ions. (JPRS)

23215 (SC-RR-67-108) CONICAL THETA-PINCH PLASMA SOURCE. Damerow, R. A. (Sandia Corp., Albuquerque, N. Mex.). Mar. 1967. Contract AT(29-1)-789. 30p. Dep. mn. CFSTI $3.00 cy, $0.65 mn.

The behavior of a novel conical theta-pinch plasma source is described. This device differs from the usual conical theta-pinch in that it has an axial, nonconducting plug which prevents the early collapse of the plasma and thus steepens the magnetic field gradient, which provides the expulsion force. Luminous front velocities as high as 16 cm/μsec have been observed in H_2 at a pressure of two torr. (auth)

23216 (UCRL-70200) SYSTEM FOR GUIDING A RELATIVISTIC HIGH-CURRENT ELECTRON BEAM. Sherwood, William A. (California Univ., Livermore. Lawrence Radiation Lab.). Feb. 27, 1967. Contract W-7405-eng-48. 14p. (CONF-670307-25). Dep. mn. CFSTI $3.00 cy, $0.65 mn.

From National Particle Accelerator Conference, Washington, D. C.

A system now in use for guiding a 400 A, 4-MeV electron beam through the Astron linear induction accelerator is described. The guiding system elements consist of iron-shrouded and air core coils of special design. Hand calculations, measurements on experimental lenses, and design modifications indicated by on-line use have resulted in the evolvement, at modest cost, of reliable beam guiding elements capable of directing more than 400 A through the 40 foot length of the Astron accelerator. Unique features of the guiding system element controls are presented, and effects of these controls on accelerator beam parameters are discussed. (auth)

23217 GAS-IONIZING SHOCKS IN A MAGNETIC FIELD. Cowley, M. D. (Cambridge Univ., Eng.). J. Plasma Phys., Pt. 1, 1: 37-54(Feb. 1967).

Ionizing shocks for plane flows with the magnetic field lying in the flow plane are considered. The gas is assumed to be electrically conducting downstream, but nonconducting upstream. Shocks whose downstream state has a normal velocity component less than the slow magneto-acoustic-wave speed and whose upstream state is supersonic are found to be nonevolutionary in the face of plane magneto-acoustic disturbances, unless the upstream electric field in a frame of reference where the gas is at rest is arbitrary. Velocity conditions are also determined for shock stability with the electric field not arbitrary. Shock structures are found for the case of large ohmic diffusion, the initial tempera-

ture rise and ionization of the gas being caused by a thin transition having the properties of an ordinary gasdynamic shock. For the case where shocks are evolutionary when the upstream electric field is arbitrary, the shock-structure requirements only restrict the electric field by limiting the range of possible values. When shocks are evolutionary with the electric field not arbitrary, they can only have a structure for a particular value of the electric field. Limits to the current carried by ionizing shocks and the effects of precursor ionization are discussed qualitatively. (auth)

23218 OPTICAL INVESTIGATIONS OF THE AIR PLASMA EXCITATION PROCESS IN ELECTROMAGNETIC SHOCK TUBES. Nikolaevskii, L. S.; Simonenko, A. F.; Grenishin, S. G. Zh. Prikl. Spektrosk., Akad. Nauk BSSR, 6: 141-7(Feb. 1967). (In Russian).

The results of many-sided investigation of characteristics of the air plasma generated in electromagnetic shock tubes with inductive excitation are stated. It is shown that such plasma parameters as temperature, particle concentration, velocity of motion of the forward front, its form, etc., do not agree with the assumption that the shock character of the gas is indicative of the discharge origin of the plasma. (auth)

23219 HOLOGRAPHY OF A LASER SPARK WITH A TEMPORAL RESOLUTION. Zaidel', A. N.; Ostrovskaya, G. V.; Ostrovskii, Yu. I.; Chelidze, T. Ya. (Ioffe Inst. of Physics and Tech., Leningrad). Zh. Tekh. Fiz., 36: 2208-10(Dec. 1966). (In Russian).

Shadowgraphs of laser-induced air breakdown were taken by means of a 3-beam setup, using a method of spatial–temporal separation of light pulses employing a system of semitransparent mirrors. Shadowgraphs can be made of various stages in the development of a single discharge. The shadowgraphs can be considered Gabor holograms of a laser spark. The electron concentration in a plasma was determined experimentally for different stages in the development of a plasma during two discharges. (TSS)

23220 INTRODUCTION TO ELECTRICAL DISCHARGES IN GASES. Brown, Sanborn C. Wiley Series in Plasma Physics. New York, John Wiley and Sons, Inc., 1966. 294p. $9.95.

The areas of physics involved are surveyed and the types of problems and techniques used in the study of electric discharges are illustrated. The physical behavior of the electrons and ions in the ionized state are emphasized and particular attention is given to the newer ideas in gaseous electronics and the physics of the plasma state. Experimental procedures and instrumental details are included only insofar as an understanding of the procedure is outlined. (M.H.R.)

Stability of Plasma

Refer also to abstract 23198.

23221 (66-C-494) THEORY OF THE ANODE SHEATH IN THE ELECTRIC ARC. Terhune, J. H. (General Electric Co., Schenectady, N. Y. Research and Development Center). Dec. 22, 1966. 60p.

A progress report is presented on a mathematically and physically consistent theory of the anode sheath in high-current electric arcs. Details of the most recent theoretical model are given as well as preliminary results of less detailed versions of the theory. Some conclusions are reached concerning the steady-state and time-dependent behavior of the uncontracted anode sheath in nonthermal collision-dominated arcs. The theory is based on a three-fluid model of the sheath, with variable mean free path for each species, and including variable ionization and recombination phenomena. Major emphasis is placed on numerical solution of the sheath equations for several steady-state conditions, with results given graphically. Stability of the fully ionized sheath is briefly considered, using a normal mode analysis and assuming that the quiescent sheath is slowly varying. It is shown that there can exist a certain range of arc parameters for which there are no stable wave solutions descriptive of perturbations about the equilibrium state. Mechanisms for and manifestations of arc instabilities arising from anode phenomena are discussed, with the results that in the high-current case a unique solution for the quiescent sheath may not exist, or if it does, the equilibrium it represents is unstable. (auth)

23222 (AD-642936) LITERATURE SURVEY ON PLASMA INSTABILITIES. Cap, F.; Faiser, H.; Friedel, H.; Herrnegger, F.; Lackner, K. (Innsbruck Univ. (Austria). Institut fuer Theoretische Physik). Oct. 1, 1966. Contract AF 61(052)-675. 41p. (AFOSR-66-2705). CFSTI $3.00 cy, $0.65 mn.

A short review is given of the various points of view under which the theoretical approach is possible. Interchange instabilities are then treated, which cover the largest field of phenomena, among them the so called negative V systems and ballooning modes. The influence of finite resistivity and current-carrier mass is next considered. A unified approach to resistive and microinstabilities completes the survey. (TAB)

23223 (AD-643355) GENERAL THEORY OF RESISTIVE BEAM INSTABILITIES. Weinberg, Steven (Institute for Defense Analyses, Arlington, Va. Jason Div.). May 1966. Contract SD-50. 109p. (RP-P-263; IDA-HQ-66-4868). CFSTI $3.00 cy, $0.65 mn.

A study was made of all resistive instabilities of a self-pinched cylindrically symmetric beam of charged particles in a finite or infinite ohmic plasma channel. The problem is reduced to an ordinary second-order linear differential equation for the longitudinal component of the perturbed electric field. The equation can be solved for a uniform beam shape, yielding an implicit transcendental equation whose roots define the various modes. It is found that for each azimuthal quantum number m there are two infinite sequences of modes and two exceptional modes, except that some of these modes are missing for m = 0, 1, and 2. In all modes stable oscillation is found at very low and very high frequencies, and instability at intermediate frequencies, the growth rates generally reaching maxima somewhat less than the betatron frequency. The largest maximum growth rate is in the "hose" mode (the only exceptional mode for m = 1) where it is approximately 0.29 betatron frequency. For a general smooth beam shape the catalog of modes is similar to that for a uniform beam, except that there also appears a continuous spectrum. (auth)

23224 (CEA-R-3130) PROPAGATION ET DIFFUSION D'UNE COLONNE DE PLASMA DANS UN CHAMP MAGNETIQUE. (Propagation and Diffusion of a Plasma Column in a Magnetic Field). Bottiglioni, Franco; Coutant, Jacques; Gadda, Erio; Prevot, Francois (Commissariat a l'Energie Atomique, Fontenay-aux-Roses (France). Centre d'Etudes Nucleaires). Dec. 1966. 38p. (In French). (EUR-3228.f). Dep. mn.

A plasma column is created in a magnetic field by longitudinal diffusion from a low-pressure pulsed discharge in hydrogen. Depending on the discharge conditions, two regimes are obtained in which the gas pumping speed has a different effect upon the plasma density in the column. Calculations are presented which can explain this effect by a difference in the transverse diffusion coefficient. (auth)

23225 MEASUREMENT OF GROWTH AND DAMPING RATE OF RESISTIVE INSTABILITY IN GASEOUS PLASMA. Saito, Susumu; Hatta, Yoshisuke (Tohoku Univ., Sendai). Appl. Phys. Lett., 10: 287-8(May 15, 1967).

Time rates of growing and damping of resistive instability in gaseous plasma in crossed fields are measured. The discharge tube used is a coaxial cylindrical type with a grid. By means of an external excitation of damping waves or an observation of the transient of self-excitation of waves by an abrupt change of the magnetic field strength, the damping or the growth rates can be determined. The results thus obtained agree with those indicated theoretically. (auth)

23226 EFFECT OF FINITE ION LARMOR RADIUS ON THE STABILITY OF SUPERPOSED FLUIDS. Kalra, G. L. (Univ. of Delhi). Can. J. Phys., 45: 1579-85(Apr. 1967).

The effect of finite ion Larmor radius on the problem of stability of incompressible and infinitely conducting superposed fluids is investigated for a general direction of perturbation. It is found that whereas the interchange perturbations are stabilized in the presence of Larmor radius, the noninterchange perturbations (which affect the ambient magnetic field) lead to overstability due to Larmor radius effects in a configuration (unstable in the absence of magnetic field) stabilized by a strong enough magnetic field. The configuration which is monotonically unstable in the absence of Larmor radius now, in addition, exhibits overstable modes. Similar conclusions are obtained in the presence of vortex sheet as well. (auth)

23227 INSTABILITY, CONNECTED WITH THE LOSS CONE OF A PLASMA WITH HOT ELECTRONS. Korablev, L. V. JETP Lett. (USSR)(Engl. Transl.), 5: 111-16(Mar. 1, 1967).

Translated from Zh. Eksp. Teor. Fiz., Pis'ma Redaktsiyu, 5: 137-41(Mar. 1 1967).

The instability connected with the loss cone in a plasma with hot ions and cold electrons was considered earlier. A similar instability can arise in a plasma placed in a magnetic mirror trap and consisting of hot electrons whose velocity distribution function is zero in the loss cone and is much higher than that of a cold plasma with isotopic distribution function. An analysis is presented for this instability for various initial conditions. (M.O.W.)

23228 QUASI-LINEAR THEORY OF THE LOSS-CONE INSTABILITY. Galeev, A. A. (IAEA, Trieste, Italy). J. Plasma Phys., Pt. 1, 1: 105-12(Feb. 1967).

The loss-cone instability of plasma confined in a mirror-type trap is considered. Relaxation of the particle distribution in the trap with a length larger than the mean free path between "turbulent" collisions is described by conventional quasi-linear theory. A quasi-linear equation for the ion distribution is solved analytically for the case of a small loss-cone volume of particles in velocity space (it takes place, for instance, in the case of a trap with a larger mirror ratio). (auth)

23229 RESONANTLY UNSTABLE OFF-ANGLE HYDROMAGNETIC WAVES. Kennel, C. F.; Wong, H. V. (IAEA, Trieste, Italy). J. Plasma Phys., Pt. 1, 1: 81-104(Feb. 1967).

The cyclotron resonance instability is considered for ion cyclotron and magnetosonic waves propagating at an angle to the magnetic field in an infinite uniform plasma. The velocity distributions of electrons and ions consist of a dense cold component and a diffuse high-energy tail. If the high-energy protons are sufficiently intense and their pitch angle distributions sufficiently anisotropic, instability occurs for those waves propagating parallel to the magnetic field. If the spectrum of resonant protons is sufficiently hard, a reasonably large cone of propagating angles about the magnetic field can be unstable. Observed fluxes of trapped protons in the magnetosphere should destabilise the ion cyclotron wave at a lower intensity threshold than for at least one class of electrostatic waves. (auth)

23230 COMBINED TAYLOR AND HELMHOLTZ INSTABILITY IN HYDROMAGNETICS INCLUDING HALL EFFECT. Talwar, S. P.; Kalra, G. L. (Univ. of Delhi). J. Plasma Phys., Pt. 1, 1: 145-55(Feb. 1967).

The problem of combined Rayleigh–Taylor and Kelvin–Helmholtz instability for incompressible plasmas carrying a uniform magnetic field is investigated taking account of the Hall current. The resistivity and the finite ion Larmor radius effects are left out. It is found that the finite Larmor frequency is destabilizing in nature. The growth rate of an otherwise (without the Hall current) unstable configuration is increased, and unstable modes may be produced in otherwise stable situations for reasonably large values of the Hall current. The Hall effect also results in overstable modes. (auth)

23231 STABILITY OF A PLASMA IN THE PRESENCE OF FLUCTUATING PARAMETERS. Zaslavskii, G. M.; Moiseev, S. S. (Novosibirsk State Univ., USSR). Zh. Tekh. Fiz., 36: 2217-19(Dec. 1966). (In Russian).

It is suggested that the techniques of the theory of stochastic functions be employed to discuss the stability of plasmas in the presence of randomly fluctuating perturbing forces. As an example, the stability against fluting perturbations of a plasma in a stellarator-type magnetic field in the presence of random fluctuations of the magnetic field is discussed. The problem is reduced to the solution of a Schroedinger-type eigenvalue problem for a stochastic potential. The solution is obtained under the assumption that the magnetic field fluctuations can be represented as white Gaussian noise (zero mean and delta function type correlation function). The logarithmic increment of the flute instability is increased by the random field fluctuations. (ATD)

Thermonuclear Processes

23232 (UCID-15108) ANALYSIS OF LARGE VOLUME NEUTRAL INJECTION MAGNETIC MIRROR EXPERIMENTS. Hall, Laurence S.; Hiskes, John R. (California Univ., Livermore. Lawrence Radiation Lab.). Feb. 16, 1967. Contract W-7405-eng-48. 42p. Dep. mn. CFSTI $3.00 cy, $0.65 mn.

Certain features of large volume neutral injection mirror machines, in addition to or in different emphasis from those considered in the recent Alice II proposal by Post and Damm for the next series of experiments of the "Alice" class, are critically analyzed. The neutral beam injection problem is explored in detail, both with regard to present and impending Alice and Baseball experiments and with regard to the appropriate form of a future facility. In addition, the instability problem which had previously dictated that one move toward the requirement of large plasma volume is viewed less seriously here, taking into account the possibility of alternative methods of stabilization which are discussed. It is concluded that the limitations of neutral beam technology, (e.g., $I\tau$ is currently a factor of at least 25 too small from the point of view of the streaming problem alone) suggest particular caution in predicting the feasibility of plasma build up in large volume systems for the foreseeable next series of experiments. On the other hand, with continued vigorous development of beam technology and with proper attention to the stability problem, the answer to those presently posed problems which the system with large plasma volume was intended to explore can be more effectively obtained in systems with plasma volumes of the size and nature of the present and forthcoming Baseball facilities. In order to exploit this opportunity, however, the need for an improved and flexible future facility, with the capability of multiple beam injection, is as essential in the present context as in the proposal of Post and Damm. Suggestions are offered, some of them differing only in degree from those in process, which can be incorporated in the next series of neutral injection mirror experiments. (auth)

Shielding

Refer also to abstracts 22874, 23626, and 23748.

23233 (AED-C-33-02) BIBLIOGRAPHIES IN NUCLEAR SCIENCE AND TECHNOLOGY. SECTION 33. SHIELDING RADIOACTIVE RADIATION IN NUCLEAR PHYSICS. Schmidt, Anton (comp.) Zentralstelle fuer Atomkernenergie-Dokumentation, Frankfurt am Main (West Germany)). Dec. 1966. 184p. (In Several Languages). Dep. mn.

Titles of articles in Nuclear Science Abstracts 19 (1965) or appearing in journals in 1965 are compiled. The themes of the articles listed are shielding and shielding problems with accelerators, reactors, and space vehicles; penetration, reflection, transmission, and transport of β, γ, and neutron radiation; shielding of high-energy charged particles; development and study of shielding materials; shielded vessels; investigations on shielded buildings and bunkers; and compilation of data necessary in the planning and calculation of shields. (J.S.R.)

23234 (BMwF-FBK-67-09) DIE VIELFACHSTREUUNG VON GAMMA-STRAHLUNG IN MEDIEN NIEDRIGER ORDNUNGSZAHL. (The Multiple Scattering of Gamma-Rays in Media With Low Atomic Number). Schaarschmidt, A. (Frankfurt Univ. (West Germany). Institut fuer Angewandte Physik). Jan. 1967. 112p. (In German). Dep. mn.

The energy spectra of multiply scattered gamma radiation in sand from point sources of ^{60}Co and ^{137}Cs were measured with a scintillation spectrometer and were corrected according to the matrix method. A theory was developed which distinguishes three groups of radiation: the primaries; the hard, forward-running secondaries; and the softer, diffusing secondaries. Both experiments and theory lead to a quasiequilibrium. The quality of the secondary radiation becomes independent of the distance from the source, but the intensity of the secondaries relative to the primaries grows with distance. An exact knowledge of the scattered radiation is important for solving problems of radiation protection. (auth)

23235 (LA-3573) QAD: A SERIES OF POINT-KERNEL GENERAL-PURPOSE SHIELDING PROGRAMS. Malenfant, Richard E. (Los Alamos Scientific Lab., N. Mex.). Oct. 1966. Contract W-7405-eng-36. 195p. Dep. CFSTI.

QAD is the generic designation for a series of point-kernel computer programs designed for estimating the effects of gamma rays and neutrons that originate in a volume-distributed source. Gamma ray dose rates, energy depositions, uncollided fluxes, and associated quantities; as well as interpolated moments-method neutron fluxes, energy depositions, and dose rates, may be calculated. Surfaces, defined by quadratic equations, are used for a three-dimensional description of the physical situation. Speed, flexibility, and ease of use, as well as the ability to mockup any direct-beam radiation problem, contribute to the utility of the program. (auth)

23236 (N-66-19708) PLASMA RADIATION SHIELDING. Levy, R. H.; Janes, S. (Avco-Everett Research Lab., Everett, Mass.). Dec. 1965. Contracts NASw-1101; AF49(638)-1553. 29p. (NASA-CR-71254; AMP-179). CFSTI $3.00 cy, $0.65 mn.

The principles of operation of the Plasma Radiation Shield are explained and the current status of research on this project is described. The relationship between this device and others using crossed field electron beams (such as the microwave magnetron) is indicated. (auth)

23237 (N-67-14461) PRELIMINARY REPORT ON ENERGETIC SPACE RADIATION AND DOSE RATE ANALYSIS. Burrell, M. O.; Wright, J. J.; Watts, J. W. (National Aeronautics and Space Administration, Huntsville, Ala. George C. Marshall Space Flight Center). Oct. 31, 1966. 43p. (NASA-TM-X-53531). CFSTI $3.00 cy, $0.65 mn.

A compendium of the environmental data on trapped and untrapped radiation and the calculated tissue dose rates received from these radiations and their secondaries behind various shield thicknesses is presented. Energetic radiation, as used here, refers to particles with energies greater than about 500 keV. The results given should be of practical value for preliminary analysis of the radiation hazard to man during space flight. (auth)

23238 (ORNL-4046) ANALYTIC REPRESENTATION OF NONELASTIC CROSS SECTIONS AND PARTICLE-EMISSION

SPECTRA FROM NUCLEON–NUCLEUS COLLISIONS IN THE ENERGY RANGE 25 TO 400 MeV. Alsmiller, R. G. Jr.; Leimdorfer, M.; Barish, J. (Oak Ridge National Lab., Tenn.). Apr. 1967. Contract W-7405-eng-26. 126p. Dep. mn. CFSTI $3.00 cy, $0.65 mn.

Analytic fits, obtained by the method of linear least squares, to the intranuclear-cascade data generated by H. W. Bertini are given. For both protons and neutrons incident on the elements C, O, Al, Cr, Cu, Ru, Ce, W, Pb, and U, analytic expressions are given for the nonelastic cross section as a function of energy; the cascade neutron- and proton-emission spectra in the angular intervals 0 to 30, 30 to 60, 60 to 90, and 90 to 180°; the evaporation neutron- and proton-emission spectra (assumed isotropic); and the cascade neutron- and proton-emission spectra integrated over all angles. (auth)

23239 (ORNL-tr-1524) EXPERIMENTAL DETERMINATION OF GEOMETRY EFFECTS IN THE MEASUREMENT OF BUILD-UP FACTORS FOR GAMMA RADIATION IN CONCRETE. Heinze, K. Translated for Oak Ridge National Lab., Tenn., from report ABS-THH-1021. 43p. Dep. mn. CFSTI $3.00 cy, $0.65 mn. JCL $4.60 fs, $1.49 mf.

The problem of the dose buildup factor for the radiation field composed of unscattered and scattered radiation behind a thick slab is investigated. Two limiting cases are described. In one case, the slab is very close to the source, and the radial symmetry of the source field is fully effective. In the other case, when the slab is at a great distance from the source and its geometric extension perpendicular to the direction of unscattered radiation is sufficiently small, it is approximately located in a parallel radiation field. An experiment is described which is designed to furnish information on whether a finite irradiated area can be found for ordinary concrete slabs which permits a measurement of dose buildup factors with a minimum deviation compared to those for an infinite surface. (M.H.R.)

23240 CALCULATION OF THE DOSE-RATE OF SCATTERED GAMMA RADIATION. Waechter, K. H. (Frieseke and Hoepfner GmbH, Erlangen, Ger.). Kerntechnik, 9: 62-4(Feb. 1967). (In German).

Stephenson had given a formula for the calculation of the quanta flux density at a point of the scattering field generated by an object hit by gamma radiation. If this formula is extended regarding the buildup effects and changing over from flux density to dose rate, a formula is obtained which still is suitable for evaluations and which corresponds sufficiently to measured values. (auth)

23241 ANGULAR DISTRIBUTIONS OF FAST NEUTRONS FOR HYDROGENOUS MEDIA. Degtyarev, S. F.; Kukhtevich, V. I.; Suvorov, A. P.; Tarasov, V. V.; Tikhonov, V. K.; Tsypin, S. G. At. Energ. (USSR), 21: 392-4(Nov. 1966). (In Russian).

Angular distributions of fast neutrons on lithium hydride and water films were measured at $E \geq 0.7$ MeV. The results were tabulated as a function of the target thickness and were compared with theoretical calculations by the transmission matrix method, the Monte Carlo method, and the final dispersion method. There was satisfactory agreement between theory and experiment. (J.S.R.)

23242 PENETRATION OF FAST NEUTRONS THROUGH THICK LITHIUM HYDRIDE SHEETS. Bozin, G. M.; Degtyarev, S. F.; Kukhtevich, V. I.; Sinitsyn, B. I.; Staroverov, V. B.; Tikhonov, V. K.; Tsypin, S. G. At. Energ. (USSR), 21: 394-5(Nov. 1966). (In Russian).

Attenuation of fast neutron beams in lithium hydride films with a density of 0.5 g/cm^3 was experimentally investigated. Data on dependence of the attenuation on the thickness of the lithium hydride under conditions of good and bad geometry were compared with theoretical data; the agreement was good. The dependence of the accumulation factor on the thickness of the lithium hydride was also determined. (J.S.R.)

23243 DOSE BUILDUP FACTORS OF PLANE PARALLEL BARRIERS FOR ^{137}Cs PLANE MONODIRECTIONAL SOURCE. Tamura, Kozo (Kimura Entetsu Kagaku Kikai Co., Ltd., Ueshima, Japan); Tsuruo, Akira. Nucl. Sci. Eng., 28: 144-5 (Apr. 1967).

The total dose transmission and linear attenuation coefficients were obtained for eight materials: graphite; water; ordinary glass; aluminum; ordinary concrete; magnetite concrete; iron; and lead. These linear attenuation coefficients are shown. Monte Carlo calculations, using a systematic sampling, were also made to compare with the experiments. The dose buildup factors obtained, both theoretical and experimental, are shown as a function of the atomic number. The total dose transmissions through iron, ordinary concrete, and lead are given. (M.H.R.)

Solid-State Physics

Refer also to abstracts 22879, 22880, 22939, 23021, and 23175.

23244 (AD-802845) ENERGY TRANSFER DURING TRANSIENT NUCLEAR PULSES. Final Report, March 1, 1962–April 30, 1964. Kallmann, Hartmut P. (New York Univ., N. Y. Radiation and Solid State Lab.). May 1964. Contract DA-36-039-SC-89180. 25p.

A method was developed that allows the investigation of the effect of x rays on insulators without applying an external field during the x irradiation. This is done by electrically polarizing anthracene crystals either by light or by x rays with an external field present and to investigate the effect of x rays only in the internal electric polarization field of the crystal. This method has been successfully applied and has shown that x irradiation with an external field present produces internal electric polarization which persists for more than one hour after the x rays and the internal field have been removed. This x-ray radio-internal polarization also develops when the anthracene crystal is mounted between two electrodes which are only pressed on the surface of the crystal. Such a contact presents a large barrier resistance for the charges produced by the x rays in the crystal, which impedes their free flow into the electrode. During the last period of the program it was found that similar polarizations can be produced in polystyrene and can be influenced by x irradiation. (P.C.H.)

23245 (COO-1052-7) INVESTIGATION OF ENERGY TRANSFER PROCESSES BY FLASH PHOTOLYSIS (RADIATION EFFECTS IN SOLIDS). Progress Report No. 9. Grossweiner, Leonard I. (Illinois Inst. of Tech., Chicago. Dept. of Physics). Feb. 1967. Contract AT(11-1)-1052. 30p. Dep. mn. CFSTI $3.00 cy, $0.65 mn.

Work done on projects relating to radiation effects on mechanical, electrical, and optical properties of ionic solids is summarized. Optical pumping and decay of the M center triplet state and R center quartet state in irradiated KCl were investigated with pulsed-light methods. The conversion of F centers to M centers in additively colored and ^{60}Co-irradiated KCl induced by repetitive 1-μsec pulses of F light was measured as a function of repetition rate, temperature, and initial F-center density. Growth of higher F-aggregate centers in KCl was investigated by controlled optical bleaching at elevated temperatures, with emphasis on the N and T centers whose structures have not been identified. The changes in the fracture surface energy of KCl induced by ^{60}Co and x irradiation were correlated with the F-center density. A new theory of dye-sensitized electrical conductivity in ZnO films is presented, based on experimental results showing that sensitization is actually a light-induced return of electrons that migrate in the dark from ZnO to the dye. (A.G.W.)

23246 (IITRI-578P9-21) MAGNETIC PROPERTIES OF INSULATORS. Final Report, February 15, 1961–July 14, 1966. Noble, Gordon (IIT Research Inst., Chicago, Ill.). Nov. 14, 1966. Contract AT(11-1)-578. 150p. (IITRI-U6028-21). Dep. mn. CFSTI $3.00 cy, $0.65 mn.

At 4°K a portion of the electron paramagnetic resonance line of F centers at low concentrations in KCl may be photographed at a low microwave power. A portion of this spectrum is reduced by a previous application of power. The sequential procedure consists of five steps: equilibration, saturation, delay, observation, and relaxation. By use of the density matrix formalism, observation may be related to the saturation and delay processes. The saturation factor is a function of the difference between the saturating and observing fields and may be described by a shape, asymmetry, width, and depth. These depend on the duration and power of the applied saturation. The saturation factor is not symmetrical about the saturating field. The width for a steady state of the saturated region approaches a limit greater than 26 gauss as the power is increased. The transition rates were measured by applying saturation pulses varying in duration and power level. There is no growth in width in the absence of external applied power. Structure with a spacing corresponding to frequency differences ranging from 2 to 33 MHz appears in the saturated region. The saturation involves a rapid and a slow process, but the recovery is exponential. Qualitative understanding can be obtained considering Zeeman and contact hyperfine terms of the spin Hamiltonian. The states, the energy levels, and the transitions are expressed in terms of eigenvalues of angular momentum. The process of saturation accumulates effects of three types of transitions with different probability distributions. (auth)

23247 (IN-1077) MATRIX: A FORCE CONSTANT ADJUSTER PROGRAM TO OBTAIN LEAST SQUARES FIT TO OBSERVED FREQUENCIES OF MOLECULES AND CRYSTALS. Boyter, J. K.; McMurry, H. L. (Idaho Nuclear Corp., Idaho Falls). Apr. 1967.

Contract AT(10-1)-1230. 12p. Dep. mn. CFSTI $3.00 cy, $0.65 mn.

A Fortran program for the IBM 7040 is described, which is a force constant adjuster to obtain a least squares fit to observed frequencies of molecules and crystals. The input data are explained and an illustrative application to diamond is presented. (auth)

23248 (IS-T-139) HALL EFFECT OF GADOLINIUM, LUTETIUM, AND YTTRIUM SINGLE CRYSTALS. Lee, Ronald Stanley (Ames Lab., Iowa). Feb. 1967. Contract W-7405-eng-82. 80p. Dep. mn. CFSTI $3.00 cy, $0.65 mn.

Thesis.

The Hall effect of gadolinium single crystals was measured in the temperature range 4.2 to 340°K in magnetic fields up to 30 kOe. The Hall effect of lutetium and yttrium single crystals was measured in the temperature range 8 to 320°K in magnetic fields up to 7.8 kOe. For the lutetium and yttrium single crystals the Hall coefficient was measured using an ac technique with the magnetic field applied along the c axis and in the basal plane. A large anisotropy and strong temperature dependence of the Hall coefficient was observed in both of these metals. The temperature dependence is interpreted in terms of the transition from impurity scattering at low temperatures to scattering from phonons at high temperatures. The anisotropy of the Hall coefficient observed in these crystals is interpreted in terms of the anisotropy of the Fermi surface. A dc method was used to measure the Hall effect of the gadolinium crystals. The magnetic field was applied in the a, b, and c directions. R_0, the ordinary Hall coefficient, and R_1, the extraordinary Hall coefficient, were determined as a function of temperature. R_0 is interpreted in terms of changes in the Fermi surface induced by exchange splitting of the conduction bands. R_1 has a ρ^2 temperature dependence below 160°K, where ρ is the electrical resistivity. The deviation from ρ^2 dependence is interpreted as being due to changes in the Fermi surface with temperature. (auth)

23249 (NP-16584) BIBLIOGRAPHY ON THE HIGH-TEMPERATURE CHEMISTRY AND PHYSICS OF MATERIALS IN THE CONDENSED STATE. Volume 1966, Number 4, October-December 1966. Diamond, J. J. (ed.) (National Bureau of Standards, Washington, D. C.). 75p. NBS, Washington, D. C. Free.

References are included on devices for achieving, measuring, and controlling temperatures above 1500°C, devices for physical measurements at temperatures above 1000°C; properties, at temperatures above and below 1000°C, of materials which melt above and below 1500°C; phase equilibria; and reactions at temperatures above 1000°C. (W.D.M.)

23250 (ORNL-4098) SOLID STATE DIVISION ANNUAL PROGRESS REPORT FOR PERIOD ENDING DECEMBER 31, 1966. (Oak Ridge National Lab., Tenn.). Mar. 1967. Contract W-7405-eng-26. 110p. Dep. mn. CFSTI $3.00 cy, 0.65 mn.

Brief summaries of work on 122 projects are presented. Many of the summaries are abstracts of papers published, to be published, or submitted for publication. A list of published papers is included. (A.G.W.)

23251 (TID-23773) CHARACTERISTICS OF THE THALLOUS DIMER CENTER IN SODIUM IODIDE. Herb, George Kenneth (Lehigh Univ., Bethlehem, Pa. Dept. of Physics). Oct. 1966. Contract AT(30-1)-3408. 278p. Dep. mn. CFSTI $3.00 cy, $0.65 mn.

Thesis.

Characteristics of the thallous double center (dimer) in sodium iodide were studied over the temperature range 15 to 300°K, and for thallium concentrations of 0.08 to 1.01 mole % Tl. A measurement of the lifetime of the dimer excited state resulted in a value of 7 nanoseconds as the upper limit. The method described to measure the decay time is applicable to other phosphors. The dimer decay time was found to be independent of temperature and thallium concentration for the ranges investigated. A measurement of the dimer orientation with polarized light gave a non-definitive result. In addition to the earlier proposed ⟨110⟩ orientation, the present study strongly suggests a ⟨100⟩ orientation. The model of the dimer absorption-emission process is shown to be one in which the absorption and emission processes are orthogonal. (auth)

23252 (UCRL-11852) INTERPRETATION OF ELECTRON DIFFRACTION PATTERNS FROM THIN PLATELETS. Thomas, G.; Bell, W.; Otte, H. M. (California Univ., Berkeley. Lawrence Radiation Lab.). Dec. 1964. Contract W-7405-eng-48. 33p. Dep. mn. CFSTI $3.00 cy, $0.65 mn.

Electron diffraction patterns from foils containing planar defects, e.g., precipitates or stacking faults, are considered in terms of relrods normal to the plane of the defect and/or normal to the specimen surface. The patterns can be regarded as consisting of streaked reciprocal lattices superimposed on the matrix lattice. In the materials examined, faulting did not produce any detectable physical shift of allowed reflections. The observations indicate that faulting is regular rather than random. Stacking faults and hcp precipitates in fcc crystals can not as a rule be distinguished in the early stages of formation of the precipitate. A complete analysis of the spot pattern from foils containing planar defects generally requires an accurate determination of the crystal orientation. For this purpose Kikuchi patterns provide sufficient accuracy, and an assessment of this is made. (auth)

23253 (UCRL-14929) OBSERVATION OF CRYSTAL FIELDS BY MEANS OF THE MOESSBAUER EFFECT. Borg, Richard J. (California Univ., Livermore. Lawrence Radiation Lab.). Jan. 18, 1967. Contract W-7405-eng-48. 35p. (CONF-661031-3). Dep. mn. CFSTI $3.00 cy, $0.65 mn.

From American Society for Metals, National Metal Exposition, and Congress, Chicago, Ill.

Data obtained from Au-Fe solid solutions are used to illustrate the Moessbauer technique for study of structure of metals and metallic solutions. Moessbauer spectra for six alloy compositions are shown and interpreted in terms of the nature and distribution of the atoms. The determination of the electric field gradient from Moessbauer measurements is discussed. (A.G.W.)

23254 (UCRL-16411) FURTHER APPLICATIONS OF KIKUCHI DIFFRACTION PATTERNS: KIKUCHI MAPS. Levine, E.; Bell, W. L.; Thomas, G. (California Univ., Berkeley. Lawrence Radiation Lab.). Oct. 1965. Contract W-7405-eng-48. 35p. Dep. mn. CFSTI $3.00 cy, $0.65 mn.

Composite Kikuchi electron-diffraction patterns have been obtained, which map out reciprocal space for silicon over the ⟨001-011-111⟩ stereographic triangle. These maps enable unknown diffraction patterns to be quickly solved even when they do not contain any Kikuchi poles. Unlike spot patterns, the Kikuchi patterns and maps uniquely represent the crystal symmetry. Some applications of these maps in crystallographic and electron microscopy investigations are discussed. (auth)

23255 (UJV-1627) DIE BEIMISCHUNG DER NEUTRONEN HOEHERER REFLEXIONSORDNUNGEN IM DURCH DIE DIFFRAKTION AUF DEM MONOKRISTAL VON CoFe GEWONNENEN BUENDEL. (The Admixture of Neutrons of High Reflection Arrangement in Bundles Obtained by Diffraction on Monocrystals of CoFe). Chalupa, B.; Bischof, J.; Galociova, D.; Michalec, R. (Ceskoslovenska Akademie Ved, Rez. Ustav Jaderneho Vyzkumu). Nov. 1966. 20p. (In German). DTIE.

Results of calculations of the reflection and high-order contamination in a neutron energy region 0.05 to 10 eV are presented in this paper. The second order contamination of neutrons was measured in the polarized neutron spectrometer with CoFe monocrystal for the same energy region. (auth)

23256 (UCRL-Trans-10091) STUDY OF X-RAY SCATTERING OF DEFECTS FORMED IN A SINGLE CRYSTAL OF LITHIUM FLUORIDE IRRADIATED BY THERMAL NEUTRONS AT -195°C. Lambert, M.; Lefebvre, S.; Guinier, A. Translated by T. O. Lazar (Univ. of California Lawrence Radiation Lab., Livermore), from Compt. Rend., 255: 97-9(1962). 9p. Dep. mn. CFSTI $3.00 cy, $0.65 mn. JCL $1.10 fs, $0.80 mf.

Lithium fluoride crystals irradiated by thermal neutrons at liquid nitrogen temperature and reheated to room temperature contained nonpoint defects, which were caused either directly by the irradiation and then frozen at room temperature or by partial coalescence of primary defects during the warming up. After reheating to a given temperature for a given time, the defects were of well defined size. Heating subsequent to irradiation did not have the same effect as heating during irradiation. In the latter case, cavities appeared directly on irradiation at 100°C, whereas in the former case cavities only appeared at reheat temperatures beyond 325°C. (P.C.H.)

23257 SECOND ORDER EFFECTS IN THE HYPERFINE FIELD OF ^{57}Fe IN TROILITE (ANTI-FERROMAGNETIC FeS). Hafner, S. S. (Univ. of Chicago); Evans, B. J.; Kalvius, G. M. Solid State Commun., 5: 17-19(Jan. 1967).

It has been found that taking into account second-order effects in the combined magnetic and electric hyperfine splitting gives an electric quadrupole interaction at the ^{57}Fe site in FeS about 5 times larger than previously reported. (auth)

23258 X-RADIATION EFFECTS ON ELECTROPHYSICAL PROPERTIES OF Si AND ITS P-N JUNCTIONS. I. ELECTROPHYSICAL PARAMETERS OF Si DURING X IRRADIATION. Krivov, M. A.; Potakhova, G. I. (Siberian Physical-Technical Inst., Tomsk, USSR). Izv. Vyssh. Ucheb. Zaved., Fiz., No. 6, 55-61(1966). (In Russian).

The results of an investigation of the effect of x-ray irradiation

on conductivity, concentration of charge carriers, and their mobility in a single silicon crystal with p-n type conductivity are given. It is shown that the changes in parameters, caused from x-ray irradiation, depend on irradiation intensity and similarity in p and n-type silicon. The changes in charge carrier concentration are described by an equation of linear recombination. (ATD)

23259 EFFECT OF ELECTRON IRRADIATION ON ELECTRICAL PROPERTIES OF GALLIUM ARSENIDE. Krivov, M. A.; Malyanov, S. V.; Brudnyi, V. N. (Siberian Physical-Technical Inst., Tomsk, USSR). Izv. Vyssh. Ucheb. Zaved., Fiz., No. 6, 132-4(1966). (In Russian).

Radiation effects on the electrical properties of gallium arsenide irradiated by 6.5 MeV electrons were studied using a B-15 betatron electron source and n-type conductivity specimens with current carrier concentration of 3.5×10^{15} to 7×10^{16} cm^{-3}, and mobility (2 to 4) $\times 10^3$ cm/Vsec. The Hall coefficient and conductivity of specimens as a function of temperature are plotted before and after irradiation. The data on temperature and dose effects on the changes in concentration of current carriers are used for determining the rate of reduction of current carriers in the material. The mobility of current carriers was also inhibited by the increased irradiation doses. It was revealed that acceptor type defect levels appear in gallium arsenides irradiated with fast 6.5 MeV electrons. (R.V.J.)

23260 EFFECT OF X-RAY AND ELECTRON EMISSION ON GALLIUM ARSENIDE P-N JUNCTIONS. Krivov, M. A.; Malyanov, S. V. (Siberian Physical-Technical Inst., Tomsk, USSR). Izv. Vyssh. Ucheb. Zaved., Fiz., No. 6, 135-6(1966). (In Russian).

A study was made of the effect of x ray and electron emission on the volt-ampere characteristics of gallium arsenide p-n junctions with the initial concentration of the current carriers of $\sim 4 \times 10^{15}$ cm^{-3} and mobility of 3500 cm^2/Vsec. The irradiation of the p-n junctions was accomplished using x rays and electrons with energies of 90 keV and 6.5 MeV respectively. On the basis of the results obtained the following was established: (1) direct and reverse currents in p-n junctions are increased owing to the appearance of non-equilibrium current carriers during x-ray irradiation. Because of imperfections in gallium arsenide crystals, the speed of the recombination of current carriers was sufficiently high, and the observed changes of characteristics during irradiation were much smaller than changes during the irradiation of germanium and silicon diodes. The coefficient of rectification of p-n junctions during irradiation varies by as much as 40% from the initial value. (2) The reverse current of p-n junction irradiated by electrons increase sharply in the pre-breakdown voltage regions, and the breakdown voltage is decreased. This reverse branch of the characteristic can be explained by the development of radiation defects in the p-n region of the junction. It is concluded that the gallium arsenide p-n junctions are stable during irradiation by x-rays and fast electrons. The coefficient of rectification of irradiated electrons of the p-n junction decreases as the radiation dose increases. It decreases by 10% when the integral electron flux is $\sim 1.5 \times 10^{16}$ cm^{-2}. (ATD)

23261 EFFECT OF REVERSE SCATTERING DURING BREMSSTRAHLUNG PASSAGE THROUGH ALKALI METAL HALIDE CRYSTALS ON THE ABSORPTION COEFFICIENT. Vorob'ev, V. A. (Tomsk Polytechnic Inst., USSR). Izv. Vyssh. Ucheb. Zaved., Fiz., No. 6, 158-60(1966). (In Russian).

A thin-walled ionization counter and cactus type x-meter were used in the investigation of increased absorption dose from 30 MeV betatron bremsstrahlung during reverse scattering in alkali-halide salt monocrystals (lithium fluoride, potassium chloride, potassium bromide and potassium iodide). The absorption coefficient curves were plotted as functions of the thickness of monocrystals. The relative increase of the bremsstrahlung absorption coefficient (in the KCl and other monocrystals) at the expense of reverse scattering was about 10%. However, a background screen with different atomic number than the examined crystals changes the magnitude of bremsstrahlung absorption coefficient during reverse scattering in the crystals. (R.V.J.)

23262 DIFFRACTION OF NEUTRONS AND X RAYS BY A VIBRATING QUARTZ CRYSTAL. Klein, A. G. (Univ. of Melbourne); Prager, P.; Wagenfeld, H.; Ellis, P. J.; Sabine, T. M. Appl. Phys. Lett., 10: 293-5(May 15, 1967).

Experiments on the diffraction of neutrons and x rays by a piezoelectrically vibrating quartz crystal have shown the following phenomena: large increases of the diffracted intensity relative to the nonvibrating crystal, modulation of the diffracted beam, and the appearance of forbidden reflections. Preliminary measurements and a qualitative explanation are reported. (auth)

23263 PHOTOSCINTILLATIONS OF KCl:Tl EXCITED IN THE F BAND. Cernyak, V. G.; Dunina, A. A.; Larionov, M. G.; Plyavinya, I. K.; Shamovskii, L. M.; Tale, A. K. (Inst. of Physics, Riga). Latv. PSR Zinat. Akad. Vestis, No. 5, 15-19 (1966). (In Russian).

An investigation was made of the rapid transfer of energy from F centers to activator centers and of the time necessary for such transfer when the crystals are subjected to pulsed excitation. The investigation was based on the comparison of the kinetics of activator luminescence excited directly in the center of luminescence (Tl scintillation) and in the F-absorption band (F scintillation). KCl–Tl–F crystals (0.2 or 0.5 mol % Tl in melt) were irradiated with x or gamma rays. The concentration of F centers did not exceed 5×10^{17} cm^{-3}. The crystals were placed in a metallic cryostat and excited with light pulses ($\sim 10^{-7}$ sec) from a spark. The excitation was applied alternately in the 247- and 560-nm bands. A coincidence was found between F scintillation and Tl scintillation with regard to their time characteristics in the range from room temperature to the temperature of liquid nitrogen. The time characterizing the slow exponential decay τ_{LC} (LC-long component) in F scintillations changed from 2.5×10^{-7} sec to 5×10^{-5} sec with a change in temperature from 300 to 80°K. At low temperatures, a sharp emission (short component-SC) of luminescence occurs which describes the form of the exciting spark pulse, as in the case of Tl scintillation. The ratio of quantum yield of SC and LC of F scintillation is the same as for Tl scintillation in the entire range of measured temperatures, which shows that the overpopulation of the $^3P_1$ level with respect to the $^3P_0$ level at F scintillation is the same as in the case of Tl scintillation. The SC and LC of luminescence in F scintillations relate to the activator luminescence of KCl Tl, i.e., to the 305 nm band, but not to the 335-nm band, which corresponds to the hole centers. The maxima of the excitation spectra of F scintillation and absorption spectra coincide and are in the region of 560 ± 5 nm. From the experimental results, it follows that the mechanism of F scintillation formation is of the electron type. This means that during short-time crystal excitation in the F-absorption band, free electrons, which are generated in the conductivity zone, recombine with holes, which are localized due to x or gamma irradiation on the activator ion or close to it. This process is accompanied by the excitation of the activator. (ATD)

23264 ABSORPTION SPECTRA IN THE VACUUM ULTRAVIOLET REGION OF CRYSTALS LiF UNDER THE EFFECT OF REACTOR AND GAMMA IRRADIATION. Podin', A. V. (Inst. of Physics, Riga). Latv. PSR Zinat. Akad. Vestis, No. 5, 124-6 (1966). (In Russian).

The rate of additional optical absorption of LiF crystals in the vacuum ultraviolet at 11 to 5 eV was investigated. The optical absorption of crystals irradiated by unfiltered reactor irradiation in a horizontal experimental channel up to absorption doses of 8 Mrad was measured in a VMR-2 vacuum monochromator. Results show that the absorption in the vicinity of 7 and 6.5 eV was higher than at 8.5 and 7.9 eV. Absorption patterns, in general, of γ-irradiated specimens do not differ from those irradiated in the reactor; however, at identical absorption doses, the color centers are formed more effectively by γ radiation. Additional absorption coefficients at 6 to 9 eV in the F band of LiF crystals prepared in vacuum is higher than in LiF crystals prepared in air. This shows that the impurities affect the rate of formation of color centers. (R.V.J.)

23265 NUCLEAR MAGNETIC RESONANCE OF MICROSAMPLES. Frost, D. J. (Unilever Research Lab., Bedford, Eng.); Hall, G. E.; Green, M. J.; Leane, J. B. Chem. Ind. (London), No. 3, 116-17(Jan. 21, 1967).

For NMR spectra, samples of several milligrams are normally required when employing protons and larger amounts with other nuclei. Of various refinements proposed to enhance sensitivity the following appear most useful—the use of a spherical microcell, employment of a digital computer for spectra summation, and numerical curve smoothing. This paper reports spectra obtained incorporating all these refinements, using a Perkin–Elmer R.10, 14,094 gauss NMR spectrometer. The spherical microcells are disposable. Experimental details are given. Spectra are reproduced for several organic compounds. An NS-544 digital memory oscilloscope was used for spectral accumulation. A splitting of 2.4 c/s was readily observed in a 600 c/s field scan. The facility for rapid accumulation of spectra on the computer allows very useful results from such nuclei as ^{31}P, ^{11}B, ^{14}N and ^{13}C. For curve smoothing the spectra were digitised on a Benson–Lehner Oscar Model E trace analyser, and calculations made using an I.B.M. 7094 computer. (UK)

23266 NUCLEAR PARAMAGNETIC RELAXATION IN SOLIDS. Philipott (Univ. of Brussels). Advances Chem. Phys., 11: 289-316(1967).

The subject is discussed under the following headings–Introduction, Brownian motion problems (Bloch equations and the phenomenological point of view, the stochastic approach, the Wangs-

ness–Bloch equations). The many-spin problem is nuclear paramagnetic relaxation (introduction, equilibrium properties, cross relaxation, evolution of the many-spin system towards equilibrium, Casper's theory, Tjon's theory). Non-Markovian processes in nuclear paramagnetic relaxation (introduction, the free precession signal, evolution of M_2 (macroscopic magnetisation)). (UK)

23267 NUCLEAR MAGNETIC RESONANCE IN DILUTE ALLOYS OF LITHIUM. Titman, J. M.; Kellington, S. H. (Univ. of Sheffield, Eng.). Proc. Phys. Soc. (London), 90: 499-509 (Feb. 1967).

Both the change in Knight shift with concentration and the quadrupole broadening the magnetic resonance of the ^{7}Li nucleus in a series of dilute lithium alloys was investigated. An attempt is made to correlate both sets of experimental data in the terms of Friedel's model of the scattering of electrons at the Fermi surface. It is shown that a set of phase shifts chosen empirically to give the experimental Knight shift also accounts satisfactorily for the residual resistivity and the quadrupolar broadened line shapes. (auth)

23268 A NEW TREATMENT OF RELATIVISTIC TERMS IN THE APW METHOD. Roessler, U. (Univ., Marburg, Ger.). Solid State Commun., 5: 45-7(Jan. 1967).

A new formulation of relativistic APW is presented, which solves a two-component equation, following from the full relativistic Dirac equation by two Foldy–Wouthuysen transformations. The two-component Hamiltonian contains the mass–velocity, Darwin, and spin–orbit coupling terms. This APW method results in a secular equation which is very similar to the nonrelativistic and also to the completely relativistic equations. (auth)

23269 NUCLEAR MAGNETIC RESONANCE IN AN InBi INTERMETALLIC COMPOUND. Setty, D. L. Radhakrishna; Mungurwadi, B. D. (Tata Inst. of Fundamental Research, Bombay). Proc. Phys. Soc. (London), 90: 495-8(Feb. 1967).

The nuclear magnetic resonance spectrum of ^{115}In was recorded at room temperature in an InBi intermetallic compound. From the observed spectrum the isotropic Knight shift (+0.18%), the axial component of the Knight shift (+0.02%) and the quadrupole coupling constant (6.6 Mc/s) at the site of the ^{115}In nucleus were measured. With the assumption of an ionic model, the quadrupole coupling constant at the site of the ^{115}In nucleus in the compound was calculated and was compared with the observed value. (auth)

23270 DEFOCUSING–FOCUSING COLLISION SEQUENCES. Petersen, M. C. E. (Univ. of New South Wales, Kensington, Australia). Austral. J. Phys., 20: 127-30(Apr. 1967).

A defocusing collision sequence with initial energy greater than the focusing energy can be converted into a focused collision sequence. This is demonstrated in the "hard sphere approximation" by taking account of the energy loss due to interaction with neighboring lattice rows. (auth)

23271 MOESSBAUER EFFECT OF ^{57}Fe IN VARIOUS HOSTS: ISOMER SHIFTS OF THE 14.4-keV GAMMA LINE OF ^{57}Fe IN DIFFERENT METALLIC LATTICES. Qaim, S. M. (Univ. of Birmingham, Eng.). Proc. Phys. Soc. (London), 90: 1065-75(Apr. 1967).

The Mössbauer spectra of ^{57}Fe, embedded as a dilute impurity in 32 different metallic host lattices, were studied. Most of the absorption spectra consisted of a single line, but in a few cases hyperfine splittings were also observed. The shifts in the energy of the 14.4-keV gamma ray, when one host element was substituted by another, were measured and appeared to be related to the electronic structure of the host. A comprehensive list of earlier data is also given. (auth)

23272 PARAMAGNETIC SCATTERING OF NEUTRONS FROM AN ISING SYSTEM. Collins, M. F.; Windsor, C. G. (Atomic Energy Research Establishment, Harwell, Eng.). Proc. Phys. Soc. (London), 90: 1015-18(Apr. 1967).

It is shown that the neutron paramagnetic scattering from an Ising system can, unlike the Heisenberg case, be solved exactly at limitingly high temperatures. The energy distribution of the scattering consists of a number of discrete levels, the envelope of which is close to Gaussian in form. The solution is given for a particular model comprising a simple cubic lattice with nearest-neighbor interactions and spin-$^5/_2$ ions. A comparison is made between the second and fourth moments of the distribution and the known moments for the Heisenberg system. (auth)

23273 NUCLEAR ORIENTATION OF ^{54}Mn NUCLEI IN IRON, COBALT, AND NICKEL. Cameron, J. A.; Campbell, I. A.; Compton, J. P.; Lines, R. A. G.; Wilson, G. V. H. (Clarendon Lab., Oxford). Proc. Phys. Soc. (London), 90: 1077-88(Apr. 1967).

Nuclei of the isotope ^{54}Mn were aligned in iron, cobalt, and nickel hosts at temperatures between 0.011 and 0.03°K. From measurements of the γ-radiation anisotropy, values for the hyperfine magnetic fields acting on manganese nuclei in dilute Fe–Mn, Co–Mn, and Mn–Ni alloys were obtained. It was shown that the hyperfine field on manganese nuclei in nickel is negative. The effects of incomplete solution of the active nuclei in the hosts and of incomplete sample magnetization upon the deduced field values in nuclear orientation experiments are discussed. The hyperfine field values obtained are compared with those from nuclear magnetic resonance experiments. It is shown that the hyperfine fields on the nuclei of copper, nickel, and cobalt atoms in dilute alloys of iron, cobalt, and nickel vary systematically with the host and localized magnetic moments, whereas there is no such simple behavior for the fields on iron and manganese nuclei. (auth)

23274 PHONON DISPERSION RELATION FOR MAGNESIUM OXIDE. Peckham, G. (Cavendish Lab., Cambridge, Eng.). Proc. Phys. Soc. (London), 90: 657-70(Mar. 1967).

Inelastic neutron scattering from magnesium oxide at room temperature was measured, and the frequencies of 656 phonons with wave vectors in mirror planes were deduced. The results are shown to be in good agreement with dispersion relations calculated on the basis of a shell model, the parameters of which were obtained from independent measurements of the elastic constants, dielectric constants, and infrared dispersion frequency. (auth)

23275 ION BOMBARDMENT-INDUCED EMISSION OF GAS FROM GLASS. Grant, W. A.; Carter, G. (Univ. of Liverpool). Brit. J. Appl. Phys., 18: 527-30(Apr. 1967).

Krypton ions were injected into Pyrex glass at temperatures of 145, 210, and 270°C. The glass was then bombarded with argon ions at various temperatures below the primary ion-injection temperature and the rate of release of the primary species observed. The variation of the bombardment-induced gas release rate with temperature shows a rapid increase as the secondary bombardment temperature approaches the primary injection temperature. These measurements, and observations of the preferential removal of gas trapped with low activation energies, suggest the operation of a thermal spike process (i.e., an effective violent local heating of the glass near the point of ion impact), which causes gas release. (auth)

23276 LOOKING AT CRYSTALS WITH A PROTON BEAM. Nelson, R. S. (Atomic Energy Research Establishment, Harwell, Eng.). New Sci., 33: 138-9(Apr. 20, 1967).

Protons scattered from single-crystal targets produce remarkably regular patterns on a fluorescent screen. This effect has been developed as a powerful new tool for studying the atomic structure of crystals—a tool which promises to find wide application. (auth)

23277 NUCLEAR MAGNETIC RESONANCE TRANSIENTS IN THE PRESENCE OF A STRONG RADIOFREQUENCY FIELD. Clough, S. (Nottingham Univ., Eng.); McDonald, I. R. Proc. Phys. Soc. (London), 90: 1019-28(Apr. 1967).

A method is described for the calculation of the time dependence of the component of the macroscopic nuclear magnetic moment of a solid in the direction of a steady magnetic field H_0 following the application of a strong, transverse radiofrequency field. Observation of the time variation of the magnetization corresponds to a free induction decay experiment performed in a frame of reference rotating at the frequency of the transverse field, and the decay function is proportional to the Fourier transform of the rotary saturation line shape. A marked lengthening of the decay is expected when the static field effective in the rotating frame is inclined at 54.7° to H_0 and the method is potentially useful as a line-narrowing technique. The theory is applied to the fluorine resonance in calcium fluoride and good agreement is found with the experimental results of Goldburg and Lee. The theory makes use of a unitary transformation method described in an earlier paper. A close correspondence is found with certain of the results already established for the related problem of motional narrowing by rapid rotation. (auth)

23278 DEFECTS IN IRRADIATED SILICON: ELECTRON PARAMAGNETIC RESONANCE AND ELECTRON–NUCLEAR DOUBLE RESONANCE OF THE ALUMINUM–VACANCY PAIR. Watkins, G. D. (General Electric Research and Development Center, Schenectady, N. Y.). Phys. Rev., 155: 802-15(Mar. 15, 1967).

An EPR spectrum produced in aluminum-doped silicon by 1.5-MeV electron irradiation is described. Labeled Si G9, it is identified as arising from an aluminum–vacancy pair, presumably formed when a mobile lattice vacancy is trapped by substitutional aluminum. The resonance is observed only upon illumination and is identified as a long-lived excited triplet ($S = 1$) state of the de-

fect. The observed hyperfine interactions with ^{27}Al and neighboring ^{29}Si nuclei, as well as the g tensor and axial fine-structure term D, are discussed in terms of a simple model of the defect using a linear combination of atomic orbitals. No Jahn–Teller distortion is observed in this excited state, as is consistent with the predictions of the model. Preferential alignment of the aluminum–vacancy axis direction in the lattice is achieved by stressing the crystal at ~200°C. The magnitude and sense of the alignment are consistent with the prediction of the model that the ground state is a Jahn–Teller distorted state similar to the phosphorus–vacancy pair previously studied. Abnormally strong $\Delta m \neq 0$ nuclear hyperfine transitions are observed in the EPR spectrum, and the theory of this effect, found only in an even-spin system, is developed. Emission is observed for some of the lines in the spectrum similar to that reported by Tanimoto et al. for another photoexcited S = 1 system. The origin of this effect is discussed in terms of the model. (auth)

23279 THERMOLUMINESCENCE IN LITHIUM FLUORIDE. Townsend, P. D. (Picatinny Arsenal, Dover, N. J.); Clark, C. D.; Levy, P. W. Contract AT(30-2)-Gen-16. Phys. Rev., 155: 908-17(Mar. 15, 1967). (BNL-10553).

Thermoluminescence has been studied in LiF crystals which were produced by a variety of growth conditions. X-ray, ^{60}Co gamma-ray, and/or optical excitation have been used to both populate and/or produce defects. Collectively, as many as 28 different glow peaks are observed in the range 20 to 550°K. However, in any one sample only about 15 of these peaks occur. The glow curves cover a range in intensity, the ratio of the strongest to weakest peaks is about 10^4, and the strongest thermoluminescence occurs near 140°K. No one glow peak is common to all samples. Some of the factors which determine the presence or absence of a glow peak are discussed. The activation energies of the major peaks have been determined by several methods. The four peaks at 115, 147, 154, and 255°K, and possibly others, follow first-order kinetics. Typical peak temperatures (°K), pre-exponential factors (sec^{-1}), and activation energies (eV) are 119, 2.7×10^{10}, 0.28; 133, 3.1×10^{9}, 0.14; 147, 8.3×10^{9}, 0.17; 158, 3.4×10^{7}, 0.29; 194, 1.8×10^{6}, 0.31; 255, 4.7×10^{8}, 0.53. The peaks at 115, 158, 194, and 255°K, and possibly others, result from electron untrapping, since they can be populated by both x irradiation and by electrons released upon irradiating a colored crystal with F-band light. The peak at 68°K has been observed only after optical re-excitation. Several of the glow peaks have been correlated with impurities, ESR data, etc. These correlations suggest specific models for the defects associated with particular glow peaks. The peak at 115°K appears to result from the H center. The peak at 133°K is impurity-sensitive and is probably caused by the untrapping of a hole from the V_K center. A Mg impurity produces peaks between 430 and 490°K, whereas Mn, Ti, Zr, or Ce merely enhance the 133°K peak. (auth)

23280 IRON-IMPURITY-CONTROLLED F-TO-M CONVERSION IN X-IRRADIATED NaF. Andrews, R. A.; Kim, Y. W. (Wayne State Univ., Detroit). Contract AT(11-1)-1054. Phys. Rev., 155: 1029-34(Mar. 15, 1967).

Comparative studies of x-irradiated NaF samples with (type-I) and without (type-II) iron impurity have been made near room temperature. The results of optical-absorption studies indicate that (1) during x-irradiation type-II samples color more readily than type-I samples, (2) optical bleaching with F light is more efficient in type-I samples, and (3) the optical bleaching process exhibits very pronounced "aging" effects in type-I samples. These results are accounted for in terms of a proposed iron-impurity-controlled mechanism of optical bleaching. This mechanism is based on the formation of cation-anion vacancy pairs, which are attributed to the excess cation vacancies associated with the iron impurity. (auth)

23281 EFFECTIVE MASS IN GROUP COLLISIONS. Veksler, V. I. (Tashkent State Univ.). Izv. Akad. Nauk SSSR, Ser. Fiz., 30: 857-9(May 1966). (In Russian).

It was previously shown (Zh. Eksp. Teor. Fiz., 49: 90(1965)) that in the scattering of an ion by a crystal lattice with simultaneous interaction between the ion and several lattice atoms (group collision), the velocity of the scattered ion is given as a function of the scattering angle in the hard elastic sphere approximation by the corresponding formula for a two-body elastic collision with the mass of the scattering atom replaced by an effective value. In the present paper, by an argument based only on energy and momentum conservation, the above theorem is extended to the case of arbitrary interaction between the scattered ion and the scattering atoms. The calculation, however, is performed only for the case of interaction with four lattice atoms initially located at the corners of a square and with the incident ion moving in a plane of symmetry. The formula derived for the effective mass, although it does not directly involve the scattering angle, involves the velocities after collision of the scattering atoms. It is argued that the maximum value of the effective mass should be a function of the maximum potential energy of the collision, and that for large scattering angles it should be a function of the energy in the center-of-mass system transferred from the ion to the lattice in the collision. Experimental data on the scattering of 40- to 260-eV Cs^+ ions through angles from 63 to 126° by a polycrystalline Mo target were obtained. The energy transfer for each scattering event (group collision) was derived from the experimental data, and the maximum potential energy was calculated from the experimental data in the hard elastic sphere approximation. The experimental effective mass for each group collision was plotted against the corresponding energy transfer and, in a separate graph, against the maximum potential energy. In each plot the experimental points fell, with some scatter, near a smooth curve. It is concluded that the effective mass depends very weakly on the scattering angle and that the force between the ion and a lattice atom falls off rapidly with increasing distance. (ATD)

23282 MODELS OF THE MECHANISM OF SCATTERING OF SLOW IONS FROM METAL SURFACES. Veksler, V. I. (Tashkent State Univ.). Izv. Akad. Nauk SSSR, Ser. Fiz., 30: 860-4(May 1966). (In Russian).

Experimental data on the scattering of low-energy (100- to 260-eV) Cs^+, Rb^+, and K^+ ions on single-crystal Mo and W targets were obtained. These data, together with some data in the literature, are discussed at length in relation to the following two models of the scattering process: the multiple scattering model in which the ion is assumed to be scattered successively by several lattice atoms, and the group scattering model in which the ion is assumed to be scattered simultaneously by several lattice atoms. The experimental technique was such that the maximum energy of the scattered ions could be determined; most of the discussion is based on the behavior of the maximum energy and of the reduced mass. The experimental data did not permit a definite choice between the two models. The data on the scattering of the smallest ions (K^+) were in best agreement with the predictions of the multiple scattering model, whereas those on the scattering of the largest ions (Cs^+) were in best agreement with the predictions of the group scattering model. Some features of the energy spectrum itself of the scattered ions are mentioned, concerning which the predictions of the two models differ. It would be possible to detect these features of the energy spectrum, however, only with a well collimated primary ion beam and high angular and energy resolutions of the scattered ions. It is suggested that future high resolution experiments may shed more light on the relative roles of the two models. (ATD)

23283 CHANGES IN RADIATION-INDUCED CONDUCTIVITY UNDER ION BOMBARDMENT. Abroyan, I. A.; Titov, A. I. (Leningrad Polytechnic Inst.). Izv. Akad. Nauk SSSR, Ser. Fiz., 30: 865-7(May 1966). (In Russian).

The effect of bombardment with 3-keV K^+ ions on the coefficient of radiation-induced conductivity (ratio of the induced conductivity to the inducing radiation flux) of a 35-Ω-cm germanium crystal has been investigated. The surface of the target was perpendicular to the [111] axis and the incbarding ions were incident in the [100] direction. A dose of 10^{14} ions/cm^2 was found to reduce the radiation-induced conductivity coefficient by an order of magnitude. The radiation-induced conductivity coefficient, as a function of the incidence angle of the inducing radiation, showed a pronounced maximum at an incidence angle of 35°, corresponding to incidence in the [110] direction. Although increasing the dose of 3-keV K^+ ions from zero to 3×10^{14} ions/cm^2 greatly reduced the conductivity coefficient, it did not affect the position and relative height of this maximum. The number of pairs of Frenkel defects due to the ion bombardment was estimated by dividing the energy dose by by half the threshold energy for producing a pair of defects. For the 3×10^{14} ions/cm^2 dose this calculation gave a defect density of 1.8×10^{18} cm^{-2}, corresponding to about 20 interstitial germanium atoms in each channel in the [110] direction. It is suggested that so high a density of defects should alter the dependence of the radiation-induced conductivity coefficient on the incidence angle, and it is concluded that the defect density was not actually so high as calculated. Two possible reasons for the discrepancy are suggested: either there may have been a partial anneal of interstitial atom–vacancy pairs, or a particle moving in the [100] direction in a germanium crystal may expend considerably more than half its energy in collisions in which the energy transfer is below the threshold for defect production. (ATD)

23284 INDUCED CONDUCTIVITY AND SECONDARY EMISSION OF SEMICONDUCTORS AND DIELECTRICS UNDER POSITIVE ION BOMBARDMENT. Abroyan, I. A.; Eremeev, M. A.; Petrov, N. N. (Leningrad Polytechnic Inst.). Izv. Akad. Nauk SSSR, Ser. Fiz., 30: 884-9(May 1966). (In Russian).

The results are reviewed of investigations conducted in the Ion Processes Laboratory of the Electronics Department of the Leningrad Polytechnic Institute concerning electron emission under ion bombardment of alkali metal halide and germanium single crystals and conductivity induced in germanium crystals by ion bombardment. For fixed energy of incident atomic ions the secondary emission coefficient of an alkali metal halide crystal decreased with increasing ion mass; the coefficient for 0.6-keV H^+ ions incident on the (100) face of an NaCl crystal was 2, and for 0.6-keV Ar^+ ions the secondary emission coefficient was 0.7. The secondary emission coefficients at 0.6-keV incident ion energy for H^+, H_2^+, and H_3^+ ions were approximately equal, but at 10 keV the secondary emission coefficients for hydrogen molecular ions were greater than for protons, and the data were not compatible with the hypothesis that the molecular ion dissociates in the first collision. The secondary emission coefficient decreased with increasing temperature of the crystal; this is ascribed to scattering of electrons on their way to the crystal surface by phonons. Measurements were made at incident ion energies down to 10 eV. Different ions behaved very differently at very low energies; for some ions (He^+ and Ne^+ on alkali metal halide crystals) the secondary emission coefficient remained finite at the very lowest energies, whereas for other ions there was a threshold energy below which secondary emission did not occur. The conductivity induced in germanium crystals by a unit flux of bombarding ions increased with increasing ion energy and decreased with increasing ion mass. From a comparison of the conductivity induced by ion bombardment with that induced by electron bombardment it was estimated that a 100-eV K^+ ion incident on germanium gives rise to about 6 electron–hole pairs. When the incident ion energy was equal to the threshold value of F. Seitz (Discuss Faraday Soc., 5: 271(1949)), at least 30% of the energy of incident H^+ ions and 5% of the energy of K^+ ions was expended in inelastic collisions. The induced conductivity was maximum and the secondary emission coefficient was minimum when the ions were incident in one of the "transparent" directions [110], [111], and [112]. From a comparison of the induced conductivity and secondary emission coefficients of germanium for electron and K^+ ion bombardment, it was estimated that only one in several thousand of excited electrons escapes from the crystal. (ATD)

23285 PENETRATION OF 2- TO 11-keV LITHIUM IONS INTO SILICON CARBIDE SINGLE CRYSTALS. Makarov, V. V.; Petrov, N. N. (Leningrad Polytechnic Inst.). Izv. Akad. Nauk SSSR, Ser. Fiz., 30: 890-1(May 1966). (In Russian).

The cathodoluminescence of SiC single crystals (α modification) previously bombarded with 2- to 11-keV Li^+ ions has been investigated in order to determine the penetration depth of the ions. Plates cut parallel to the (0001) faces were bombarded with monoenergetic Li^+ ions (dose, 10^{16} ions/cm^2), and the intensity of the 5200 Å cathodoluminescence of each plate was subsequently determined at 77°K as a function of the energy of the exciting electrons. Luminescence was observed only when the electron energy exceeded a threshold value that depended on the energy of the ions with which the crystal had previously been bombarded. It was assumed that the penetration depth of the bombarding ions was equal to that of electrons having the threshold energy. To convert the cathodoluminescence thresholds to ion penetration depths, it is necessary to know the penetration depths of electrons of different energies. As electron-penetration data are lacking for SiC, data for Si were used instead. The penetration depth in Å of a Li^+ ion with an energy of E keV was found to be $350E^{0.77}$. These penetration depths are several times greater than those found by McCargo, F. Brown, and A. I. Davies (Can. J. Chem., 41: 2309(1963)) for penetration of Na^+ ions into Al, and are very close to those found by J. Young (J. Appl. Phys., 27: 1(1956)) for penetration of H^+ and He^+ ions into Al. (ATD)

23286 ION SCATTERING BY CRYSTALS. Mashkova, E. S.; Molchanov, V. A. (Moscow State Univ.). Izv. Akad. Nauk SSSR, Ser. Fiz., 30: 854-6(May 1966). (In Russian).

The energy spectra of initially monoenergetic Ne^+, Ar^+, and Kr^+ ions scattered in the (110) plane of a copper crystal from (100) and (114) faces have been recorded in an investigation of multiple scattering of ions from crystals. Data are presented for scattering of 25-keV Kr^+ and 30-keV Ar^+ and Ne^+ ions. The ions scattered through a predetermined angle from the converging monoenergetic beam (convergence angle, 2°) by the crystal face entered the 1 × 4-mm slit (located 16.5 cm from the scattering crystal) of a 10-cm-radius 180° electrostatic energy analyzer (energy resolution, 1%) and were recorded in a Faraday cup. The spectra recorded at grazing angles from 10 to 17° and scattering angles from 27.5 to 50° showed that the contribution of doubly scattered ions to the scattered beam increased with decreasing distance between the scattering atoms (i.e., in passing from the (114) to the (100) scattering faces) and with increasing atomic number of the scattered ion. Under some conditions doubly scattered ions predominated in the scattered beam. Calculations of Yu. V. Martynenko (Fiz. Tverd. Tela, 6: 2003(1964)) indicated that the probability of double scattering should increase with increasing atomic number of the scattered ion and the scattering atom, and with decreasing energy, distance between scattering atoms, and scattering angle. The present measurements are in good agreement with these conclusions. (ATD)

23287 POSTEXCITATION CONDUCTIVITY OF THIN MAGNESIUM FLUORIDE AND ZINC SULFIDE FILMS. Serebrov, L. A.; Salin, V. I. Zh. Tekh. Fiz., 36: 2121-4(Dec. 1966). (In Russian).

Electron contact and pulse techniques were used to investigate the postexcitation conductivity induced by irradiation with 10-keV electrons in 0.5-μ MgF_2 and ZnS films vacuum-deposited on aluminum substrates. Two electron beams were employed in the experiments: a 1-μA main beam of 10-keV electrons, which was swept across the specimen at the rate of 40 m/sec and served to excite additional conductivity in the film, and a 0.2-μA auxiliary beam of 1-keV electrons, which, moving at the rate of 4 m/sec, swept out a rectangular television-type raster on the film and served both to induce surface charge on the specimen before irradiation with the main beam and to detect changes in the surface charge distribution due to postexcitation conduction. Electric fields up to 10^5 to 10^6 V/cm were achieved at the specimen surface. Two stages could be distinguished in the development of the postexcitation current and the space charge; one stage appeared comparatively rapidly, and the other, after some tens of seconds. From the presence of two components of the postexcitation current it is concluded that there are traps at at least two different energy levels. The behavior was the same whether the main electron beam traversed the target or was reflected from it; from this it is concluded that the space charge is distributed rather evenly throughout the volume of the film. The internal space charge was found to persist for 15 to 20 minutes, or perhaps longer. Internal space charges of 3×10^{-12} coulomb and postexcitation currents of 3×10^{-9} μA were recorded. It is concluded that neglect of after-effects can lead to errors in the measurement of excitation conductivity. (ATD)

23288 SURFACE-ACTIVATED SCINTILLATORS. Lushchik, Ch. B.; Lushchik, N. E.; Soovik, T. A.; Pinogorova, L. A.; Yaanson, N. A. Tr. Inst. Fiz. Astron., Akad. Nauk Est. SSR, No. 31, 160-82(1966). (In Russian).

An experimental method of making thin luminescent layers in alkali metal iodide crystals is developed. The surface-activated scintillators (with thallium and indium as activators) prepared by this method can be used for detection and spectrometry of α particles. The best resolutions in surface-activated and volume-activated KI : Tl and CsI : Tl α-particle scintillators are equal. Surface-activated KI : Tl crystals with a scintillation layer of the order of 30 to 40 μm can readily detect α particles in the presence of an intense background of γ rays. The principal advantages and shortcomings of this new variety of inorganic scintillators—surface-activated crystals—are discussed. (auth)

Theoretical Physics

Refer also to abstract 22954.

23289 (ARL-66-0194) RESEARCH ON RIEMANNIAN SPACES. Hlavaty, V. (Indiana Univ. Foundation, Bloomington). Oct. 1966. Contract AF33(657)-11550. 426p. CFSTI $3.00 cy, $0.65 mn.

A collection of papers is presented which deals with different problems connected with the fact that they are either topics of the theory of relativity or find their application in this theory. Problems considered include holonomy group, minimal curves, geometrodynamics, classification of the space–time curvature tensor, reduction of the number of unknowns in the Einstein–Maxwell field equations, Weierstrass characteristic and its significance in teleparallelism, and criticism of the clock paradox. (W.D.M.)

23290 (IC-67/9(Pt.1)) PARTIAL WAVE ANALYSIS. PART I. Boyce, J. F.; Delbourgo, R.; Salam, Abdus; Strathdee, J. (International Centre for Theoretical Physics, Trieste (Italy)). Feb. 1967. 94p. Dep. mn.

An attempt is made at a systematic and self-contained presentation of the group theoretic basis of harmonic analysis using the time-like, space-like, light-like, and null representations. It is shown how an expansion of the amplitude may be carried through, not only in the forward direction, but for all momentum transfers and for all values of helicity flip. This type of expansion, with its new separation of the kinematical factors, will allow a more sys-

tematic use of analyticity in the σ plane for all processes at all momentum transfers, possibly giving a further insight into what may yet be learned from a deeper analysis of the Poincaré group. (W.D.M.)

23291 (AD-646931) THE REALIZATION OF PARTICLE-LIKE SOLUTIONS OF THE EINSTEIN EQUATIONS FOR A SCALAR COMPLEX FIELD. Stakvilevichus, M. I. Translated from Vestn. Mosk. Univ., Ser. III, Fiz. Astron., 19: No. 6, 41-7 (1964). 14p. (FTD-HT-66-278). CFSTI $3.00 cy, $0.65 mn.

It is shown that the Einstein equation with an energy-pulse tensor of a scaler complex field in the right half allow spherically symmetrical particle-like solutions, wherein the matrix has a Schwarzschild character at great distances. In the approximation of a weak gravitational field the course of the matrix approaches that of the corresponding matrix of the Newton potential. The possibility of obtaining the spectrum of the masses of scaler particles by the solution of precise equations and the introduction of a scaler quantized quasi-charge is indicated. (auth)

23292 PROBABILITY OF POTENTIAL BARRIER PENETRATION IN THE APPROXIMATION OF THE GENERALIZED WKB METHOD. III. ASYMMETRIC BARRIER. Zhirnov, N. I. (Moscow State Pedagogical Inst.). Izv. Vyssh. Ucheb. Zaved., Fiz., No. 6, 108-13(1966). (In Russian).

The present study is a continuation of an earlier study on the penetration probability of a potential barrier. A new solution is derived for the problem of the penetration of particles through one-dimensional asymmetric barriers; the solution is more precise than the previous one. The problem is discussed concerning the limits of applicability of the generalized WKB method for computing the penetration probabilities of one-dimensional barriers. The approximate solutions derived from using the WKB method are found to be valid over the entire range of changes in particle energy. (auth)

23293 INVARIANT DEFINITION OF GRAVITATIONAL WAVES. Maldybaeva, E. Ya. (Physical-Technical Inst., Tashkent). Izv. Vyssh. Ucheb. Zaved., Fiz., No. 6, 118-19(1966). (In Russian).

All classical field theories are described by even or odd external differential shapes of a certain order, zero order by a scalar or pseudoscalar and first order by vector and pseudovector, etc. In order to describe electromagnetic fields even differential fields of the second order have been introduced. In such a case, Maxwell equations are written by means of external differentiating operators and by codifferentiating orders. Quite different from the classical theory are the gravitational fields, the presence of which is revealed by curved space-time and is determined by a difference from the zero Riemann component tensor. A description of a gravitational field is given in hyperbolic Riemann sets with quadratic $n \times n$ matrix and with local external second order differential form elements. The suggested invariant determination of gravitational waves is in good agreement with the Pirani determination and L. Likhnerovich (Theory of coherence in the total and in the holonomy groups. L.-M. 1960). (R.V.J.)

23294 NEW SOLUTION OF EINSTEIN EQUATIONS AND POSSIBLE INTERPRETATION OF DIRAC'S HYPOTHESIS OF THE DIMINISHING GRAVITATIONAL CONSTANT. Brezhnev, V. S.; Ivanenko, D. D.; Frolov, B. N. (Moscow State Univ.). Izv. Vyssh. Ucheb. Zaved., Fiz., No. 6, 119-21(1966). (In Russian).

The attempts made by P. Jordan (Rev. Mod. Phys. 34: 596 1962) and C. Brans et al. (Relativity Groups and Topology, N. Y.-London, 1964, p. 241) to give a general covariant description of the variable gravitational constant took them beyond the frame of the general theory of relativity and thus they encountered great difficulties in correlation with experimental data. An attempt is made on a new interpretation of Dirac's hypothesis. It is shown that it is possible to describe in an inherent way the effective variations of the gravitational constant with time. As an example the case of a spherically symmetric distribution of a substance with energy tensor $T^{\mu\nu} = (E + p)u^{\mu}u^{\nu} - pg^{\mu\nu}$ is analyzed. (R.V.J.)

23295 PROBABILITY OF POTENTIAL BARRIER PENETRATION IN APPROXIMATION OF THE GENERALIZED WKB METHOD. II. SYMMETRIC BARRIER. Zhirnov, N. I. (Moscow State Pedagogical Inst.). Izv. Vyssh. Ucheb. Zaved., Fiz., No. 6, 101-7(1966). (In Russian).

This study was undertaken in an attempt to eliminate the drawback of the approximate method in computing the penetration coefficients through one-dimensional potential barriers. Such deficiency is removed by superposing some complementary conditions on the base potential W(S). A new solution is given to the problem of the penetration of particles through symmetric barriers. (ATD)

23296 ORBITAL SELF-CONSISTENT-FIELD THEORY. I. GENERAL THEORY FOR MULTICONFIGURATIONAL WAVE FUNCTIONS. Adams, William H. (Pennsylvania State Univ., University Park). Phys. Rev., 156: 109-17(Apr. 5, 1967).

A general formulation of multiconfigurational self-consistent-field theory is given. The fundamental condition to be satisfied by the M occupied orbitals ψ_μ of an N($\leq$ M)-body system, in order that the total energy of one state be extremalized, is expressed in terms of the fundamental invariant $\rho = \Sigma_{\mu=1}^{M} |\psi_\mu\rangle\langle\psi_\mu|$. The condition placed on ρ is of the same form as the condition on the fundamental invariant of the Hartree–Fock theory. Setting M = N, the unrestricted Hartree–Fock equations are derived from the condition on ρ. For M > N there are three freedoms one may take with the fundamental condition on ρ. Exploiting any or all of these freedoms yields alternative forms of the fundamental condition. This enables us to derive an effective one-body Hamiltonian, which is the sum of a Hartree-type Hamiltonian and a correlation and exchange operator. For finite M > N, the one-body Hamiltonian contains a nonlocal exchange and correlation operator. This operator is defined in terms of the one- and two-body density matrices. The connection between the orbitals of this theory and those of the Hartree–Fock theory is explored. The theory as outlined here is applicable to any system of N identical particles, but our discussion is oriented towards electronic systems. The theory contains most self-consistent-field theories as special cases, and gives a basis for the self-consistent-field formulation of others. (auth)

23297 GRAVITATIONAL MOTIONS OF COLLAPSE OR OF EXPANSION IN GENERAL RELATIVITY. McVittie, G. C. (Univ. of Illinois, Urbana). Ann. Inst. Henri Poincare, Sect. A, 6: No. 1, 1-15(1967).

Einstein's equations of general relativity are solved exactly for a class of spherically symmetric distributions of matter in motion. The solutions for the interior of the distribution are obtained by using the motions of a co-moving coordinate system and the isotropy of internal stress, which is reduced to a pressure. This is zero at the outer boundary of the configuration and density and pressure gradients exist within the distribution. The speed of the motion is calculated. The theory has analogies with that of spherical blast waves in classical gas dynamics; it is also applicable to gravitational collapse. (auth)

23298 MODEL FOR THE DECAY OF AN UNSTABLE STATE. Razavy, M. (Univ. of Alberta, Edmonton). Can. J. Phys., 45: 1469-71(Apr. 1967).

A nonrelativistic model for the decay of an unstable system, in which the mean energy of the unstable state and the rate of decay are finite, is discussed. (auth)

23299 MOTION OF TWO INTERACTING CHARGED PARTICLES IN A HOMOGENEOUS MAGNETIC FIELD. Polyak, Yu. Ya. (Ural Polytechnic Inst., Sverdlovsk, USSR). Prikl. Mat. Mekh., 31: 64-71(Jan.-Feb. 1967). (In Russian).

A general method for reducing the order of the Hamiltonian equation according to a known integral was suggested previously. The nonrelativistic problem of two interacting charged particles moving in a homogeneous stationary field is resolved here by means of the method. Using four known integrals of motion (exclusive of energy integrals) the problem was reduced to monominal problems of relative motions. (tr-auth)

23300 STABLE CHARGED SPHERE IN GENERAL RELATIVITY. Sharma, N. K. (Univ. of Rajasthan, Jaipur, India). Nuovo Cim. (10), 48A: 975-81(Apr. 21, 1967).

The internal energy term (λ) in Dirac's gravitational particle model has been replaced by electromagnetic energy appropriately. It is shown that the modified model remains stable as long as spherical symmetry is maintained. (auth)

23301 CHARGED DUST CYLINDER IN GENERAL RELATIVITY. Som, M. M. (City Coll., Calcutta). Proc. Phys. Soc. (London), 90: 1149-51(Apr. 1967).

A previous result of the author about the impossibility of constructing a physically acceptable solution of the Einstein–Maxwell equations corresponding to an infinite charged cylinder is generalized. (auth)

23302 ENERGY IN AN EXPANDING UNIVERSE. Rosen, Nathan (Israel Inst. of Tech., Haifa). Ann. Phys. (N. Y.), 42: 334-42(Apr. 1967).

One can define as the energy of a particle, or of a system of particles, two quantities W and W* = Wf, where f is proportional to the radius of the universe. The first is related to the active gravitational mass, the second to the inertial mass and the passive gravitational mass. W is the value of the Hamiltonian and is very nearly constant for bound atomic energy levels. Hence it is reasonable to call it the energy, while W* might be called simply the mass, in the case of an isolated system. During a short time in-

terval, the conservation of energy can be described in terms of either W or W*, but in the general case neither one is conserved. However, in the case of radiation, W* is constant, while W changes with time in a way that is related to the Hubble red shift. (auth)

23303 NOTE ON UNIQUENESS FOR A ONE-DIMENSIONAL TWO-BODY PROBLEM OF CLASSICAL ELECTRODYNAMICS. Driver, Rodney D.; Norris, Michael J. (Sandia Lab., Albuquerque, N. Mex.). Ann. Phys. (N. Y.), 42: 347-51(Apr. 1967).

A previous paper [Ann. Phys., 21: 122(1963)] gave a mathematical analysis of a two-body problem of classical electrodynamics incorporating retarded interactions (for the case of two charged particles remaining on the x axis). It was shown that the future trajectories would be uniquely determined, and well behaved, if past histories of the particles were given satisfying certain conditions, including a Lipschitz condition on the velocities. However, this Lipschitz condition has since become suspect as possibly unreasonable. The present note shows that it was, in fact, also superfluous. (auth)

PHYSICS (HIGH ENERGY)

Particle Interactions and Properties (Experimental)

Refer also to abstracts 21938, 22133, 23403, and 23405.

23304 (COO–1195-91) ANNUAL PROGRESS REPORT [ON ELEMENTARY PARTICLE PHYSICS RESEARCH, APRIL 1966–APRIL 1967]. Goldwasser, E. L.; Wattenberg, A.; Almy, G. M. (Illinois Univ., Urbana, Dept. of Physics). Contract AT(11-1)-1195. 47p. Dep. mn. CFSTI $3.00 cy, $0.65 mn.

The work of the counter and spark chamber groups and that of the bubble chamber group of the University of Illinois physics department is summarized. The topics covered are a summary of the scope and purpose of the project, the experimental program, development of facilities and equipment, and publications and abstracts of talks. (J.F.P.)

Weak

23305 STUDY OF THE n + d + ν CHANNEL IN MUON CAPTURE BY ^{3}He. Pascual, P.; Pascual, R. (Facultad de Ciencias, Valencia). Nuovo Cim. (10), 48A: 963-70(Apr. 21, 1967).

The capture rate of $\mu^- + {}^3\text{He} \rightarrow n + d + \nu$ was calculated assuming that the deuteron and helium three wave functions are S = 0 and spatially symmetric. The final-state interaction is taken into account. (auth)

Strong (Baryon-Induced)

Refer also to abstract 23402.

23306 (JINR-E01-3194) THE A(θ) ASYMMETRY IN ELASTIC 635-MeV pp-SCATTERING. Kiselev, V. S.; Nadezhdin, V. S.; Satarov, V. I.; Zulkarneev, R. Ya. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Nuclear Problems). 1967. 8p. Dep. mn.

The results of the A(θ) asymmetry measurements of elastic pp-scattering are described as being completely due to the totally polarized beam. The measurements were performed at 635 MeV in the angle range from 28 to 90° (cms). Earlier pp-scattering phase shifts are improved by using both the results and those of other experiments. In searching for solutions beginning from random values three solutions with $l_{max} = 5$ and two solutions with $l_{max} = 4$ are obtained. Thus, in the energy range analyzed, no evidence for the existence of a single phase-shift solution is obtained. (auth)

23307 (JINR-E1-3066) THE DESIGN OF SPECIFYING AND DISCRIMINATING NN-SCATTERING EXPERIMENTS. Fedorov, V. V.; Pazman, A. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Computing Techniques and Automation). [1966]. 16p. Dep. mn.

Some expressions are obtained which made it possible to use a sequential design of regression experiments (design with finite time) instead of the continuous design. A new method is proposed for the design of discriminating experiments. A comparison with other methods is given. (auth)

23308 (UCRL–17433) HIGH-ENERGY-PHYSICS EXPERIMENTS WITH POLARIZED TARGETS. Chamberlain, Owen (California Univ., Berkeley. Lawrence Radiation Lab.). Dec. 1966. Contract W-7405-eng-48. 56p. (CONF-661205–3). Dep. mn. CFSTI $3.00 cy, $0.65 mn.

From Conference on Polarized Targets and Sources, Saclay, France.

Experiments with polarized proton targets are reviewed in detail. These experiments include both proton–proton and meson (π)–proton interactions. Such experiments are undertaken in order to obtain knowledge of the spin dependence of the forces in strong interactions. (J.F.P.)

23309 MEASUREMENT OF THE CROSS SECTIONS AND POLARIZATIONS IN PROTON–DEUTERON ELASTIC AND INELASTIC SCATTERING AT 150 MeV. Kuroda, Kei-ichi. Cah. Phys., 20: 277-332(Aug.-Sept. 1966). (In French).

The cross section and polarization in elastic scattering and the cross section in weakly inelastic scattering were measured. A nonpolarized proton beam well defined in energy and a magnetic analyzer were used to eliminate all the ambiguities due to the resolution of the detection system. The basic ideas of the impulse approximation are first presented and the theoretical expressions of the magnitudes measured are established. The general experimental apparatus used is described. The experimental method is described in some detail. The results are analyzed and compared with the theoretical predictions calculated in the impulse approximation. The results lead to the conclusion that the simple impulse approximation can be used to interpret the p-d elastic scattering at 150 MeV up to $\theta_{lab} = 40°$ without essential disagreement. At higher angles, however, the theoretical predictions, in spite of constant improvement, give only the gross shape of the cross section and the polarization. The disagreement observed for angles above 40° seem to be connected with fundamental problems contained in the impulse approximation itself. At small angles the p-d scattering, principally weakly inelastic, can be considered as a useful method to verify the dephasing solutions or the potential proposed for nucleon-nucleon interaction in the isospin state T = 0. (J.S.R.)

Strong (Meson-Induced)

Refer also to abstract 23308.

23310 (UR-875-153) A STUDY OF RESONANCE PRODUCTION IN 7 GeV/c π^+p INTERACTIONS. Slattery, P.; Kraybill, H. (Yale Univ., New Haven, Conn.); Forman, B.; Ferbel, T. (Rochester Univ., N. Y. Dept. of Physics and Astronomy). July 29, 1966. Contract AT(30-1)-875. 32p. (CONF-660808-23). Dep. mn. CFSTI $3.00 cy, $0.65 mn.

From 13th International Conference on High Energy Physics, Berkeley, Calif.

A preliminary investigation of resonance production in 7 GeV/c π^+p interactions indicates that the production rates and characteristics of the A_1, the A_2, and the B mesons are similar to those observed at lower energies. The cross section for the channel $N^*(1238) + A_2$ is comparable in size to that for $p + A_2^+$ (~200 μb). Small A_1 and B enhancements are evident in the data. A model which considers the peripheral nature of the pion-nucleon interaction is found to be only partially successful in accounting for the A_1 and the B on the basis of their being kinematic reflections. (auth)

23311 PROPERTIES OF THE NEUTRAL A-MESONS. Cohn, H. O. (Oak Ridge National Lab., Tenn.); McCulloch, R. D.; Bugg, W. M.; Condo, G. T. Nucl. Phys., B1: 57-64(1967).

The neutral three pion systems ($\pi^+\pi^-\pi^0$) from the reaction $\pi^+ + n \rightarrow p + \pi^+ + \pi^- + \pi^0$ at 3.29 GeV/c, is examined in the mass region of the A mesons. It is shown that the enhancement at 1310 MeV can be identified with the neutral component of the A_2 meson. However, no compulsive evidence is found for the neutral component of the A_1 meson even though the unrestricted three-pion mass spectrum demonstrates an enhancement in the region from 900–1200 MeV. There is also an indication that the H meson is present in this reaction. (auth)

23312 NO EVIDENCE FOR S^0 MESON. CERN Cour., 7: 69-70(Apr. 1967).

An experiment is reported which indicates that the meson (S^0) of mass 730 MeV does not exist. The experimental arrangement enabled the previous counter experiment, which claimed the observation of the S^0 to be precisely repeated. About 150 events corresponding to the well-established meson (ω^0) were observed, and on the basis of this figure some 350 to 600 events corresponding to S^0 should have appeared. However, the results showed no evidence for the existence of the S^0. (J.F.P.)

Particle Interactions and Properties (Theoretical)

Refer also to abstract 23406.

General

23313 (AD–644486) ON THE ORIGIN OF THE SCALE-CONSTANTS OF PHYSICS. Final Report. Bastin, Edward W. (Cambridge Language Research Unit (England)). May 1966. Contract AF-EOAR-78-65. 38p. (AFOSR–66-2862). CFSTI $3.00 cy, $0.65 mn.

An approach is presented to the problem of describing a particle in a field without assuming a space-time continuum that is deduced primarily from simple assumptions concerning interactions between the elements of a "bootstrap"-type assemblage in which each particle in the assemblage is built from the interactions of all of the others. No dynamic properties are assumed for the particles beyond the discrete all-or-none interactions. Dynam-

ics, including the momentum concept, are formulated subsequently. Numerical values are found that are identified as measures of the strengths of the main fields of physics that interact with particles. These are assumed to specify dimensionless ratios of the natural units, or fundamental constants, that are ultimately required to specify every measurement, and therefore, every particular value of each continuous dynamic variable, irrespective of how that concept is subsequently defined. The numbers identified with the dimensionless ratios are called scale-constants. (auth)

23314 (BNL–994, pp 70-102) PHYSICS. (Brookhaven National Lab., Upton, N. Y.).

Experimental and theoretical studies concerned with the structure and fundamental properties of matter are described. Descriptions of various experiments carried out on particle physics at the Cosmotron and the AGS are given, and the theoretical aspects of particle physics, instrumentation, and data processing are discussed. Other areas of physics considered are solid state, nuclear structure, theoretical physics, neutron physics, and atomic and molecular physics. (J.F.P.)

23315 (IC–67/18) ALGEBRAIC FORMULATION OF DYNAMICAL PROBLEMS. Budini, P. (International Centre for Theoretical Physics, Trieste (Italy)). Mar. 1967. 26p. Dep. mn.

It is shown how the algebraic method can be employed to solve some dynamical problems and the important role that is played in this frame, by the Casimir operators. In particular, while in the nonrelativistic case the Casimir operator of the spectral algebra gives the connection between the mass operator and the Casimir operator of the symmetry algebra, in the relativistic cases considered one has still a one-to-one dependence of the Casimir operator of the spectral algebra on that of the symmetry algebra, but this dependence is no longer sufficient to give the mass spectrum which is obtained by introducing the Casimir operator of the inhomogeneous spectral algebra which leads to an equation of the Klein–Gordon type, giving the mass spectrum implied by the equation. In this way the whole procedure is kept at the algebraic level. (J.F.P.)

Electromagnetic

23316 (JINR-E02–3205) DISPERSION SUM RULES FOR DEUTERON DISINTEGRATION PROCESSES IN POLE APPROXIMATION. Lewin, K.; Robaschik, D. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Theoretical Physics). 1967. 7p. Dep. mn.

The dispersion sum rule for the photodisintegration process gives $\mu_s = 0$ and vanishing d-state probability for the deuteron ground state in the lowest approximation. (auth)

23317 (JINR-E02–3224) ISOTOPIC INVARIANCE VIOLATION AND PION FORM FACTOR. Efremov, A. V. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Theoretical Physics). 1967. 19p. Dep. mn.

On the basis of minimal electromagnetic interaction hypothesis and some approximation the nonlinear integral equation for pion form factor is obtained. An approximate analytical solution of this equation is given, the form factor appears to be dependent only on the fine structure constant, the mass of the pion and their mass difference. The r.m.s. radius is found to be 0.3 f. (auth)

23318 ENERGY LOSS OF THE ULTRARELATIVISTIC PARTICLE PASSING THROUGH FILM. Garibyan, G. M.; Elbakyan, S. S. Izv. Akad. Nauk Arm. SSR, Ser. Fiz., 1: 279-88 (1966). (In Russian).

The full loss of the energy of the ultra-relativistic particle passing through film is calculated. The calculation has been made by Landau's method generalised for the case when one must not close the contour by a semicircle in the upper half plane. The extreme cases for the formula for thin and thick films have been considered. In case of the thin film, the ionization losses with logarithmic growth play the main role, while when the thickness of the film is great or equal to the formation zone of transitional radiation, the full loss of the energy is equal to $-(2/3)\,(e^2/c)\,(\sqrt{\sigma}/\sqrt{1-\beta^2})$. (auth)

23319 LOSS OF THE PARTICLE ENERGY PASSING THROUGH TWO-LAYER PLATE. Garibyan, G. M.; Muradyan, M. M. Izv. Akad. Nauk Arm. SSR, Ser. Fiz., 1: 310-18(1966). (In Russian).

Total energy losses of the charged particle passing through the two-layer plate are dealt with in cases when the thickness of the layer is not limited. The obtained general formula is thoroughly calculated and analyzed for the case of thin layers. When the regions of the particular frequencies of the plate layers of the matter are distant from each other, the ionization losses in both layers are shown to grow logarithmically as if there were two independent one-layer plates. (auth)

23320 PARTICLE WITH AN ANOMALOUS MAGNETIC MOMENT IN THE FIELD OF PLANE ELECTROMAGNETIC WAVE. Nagorskii, G. A. Izv. Akad. Nauk Arm. SSR, Ser. Fiz., 1: 340-2(1966). (In Russian).

The equation of Dirac for the particle with an anomalous magnetic momentum μ is reduced to the Schroedinger equation for neutral particle with spin $\frac{1}{2}$ and magnetic momentum μ. (auth)

23321 ELECTROMAGNETIC CONTRIBUTION TO THE BREMSSTRAHLUNG AND PAIR PRODUCTION PROCESSES. Costescu, A.; Vescan, T. (Bucharest Univ.). Nuovo Cim. (10), 48A: 1041-50(Apr. 21, 1967).

The contribution of the virtual Compton amplitudes to the bremsstrahlung in electron-proton scattering and photoproduction of electron-positron pairs on protons is evaluated in the single-nucleon approximation. The contribution to the differential cross section of these processes is significant. The formulas, however, do not reduce the disagreement of the experimental data of Blumenthal et al., on the pair production from carbon, with the theory. (auth)

23322 ELECTROMAGNETIC MASS DIFFERENCE OF PIONS. Das, T. (Univ. of Rochester, N. Y.); Guralnik, G. S.; Mathur, V. S.; Low, F. E.; Young, J. E. Phys. Rev. Lett., 18: 759-61 (May 1, 1967).

Using the algebra of currents and the sum rules recently derived by Weinberg, the electromagnetic mass difference of pions is calculated, and $m_{\pi^+} - m_{\pi^0} \simeq 5.0$ MeV is obtained. (auth)

23323 MAGNETIC CONTRIBUTION TO THE PROTON–NEUTRON MASS DIFFERENCE. Cornwall, John M.; Patil, Sharashchandra H. (Univ. of California, Los Angeles). Phys. Rev. Lett., 18: 757-8(May 1, 1967).

It is pointed out that there can be a quite appreciable magnetic n–p mass difference if proper account is taken of the Roper resonance at 1400 MeV with exactly the same quantum numbers as the nucleon. The $M_n - M_p$ is calculated to be approximately 2.4 MeV without the corrections for Coulomb self-energy. The Coulomb energy will decrease this value, but may be of the order of 1 MeV or less, which would bring $M_n - M_p$ as calculated to about 1.4 MeV, which is very close to the experimental value. (J.F.P.)

Weak

23324 (NP–16681) DYNAMICAL MODEL OF NONLEPTONIC DECAYS AND SCALAR MESONS. Loebbaka, David S. (Maryland Univ., College Park. Dept. of Physics and Astronomy). Sept. 1966. Contract AFOSR 500-64. 171p.

Thesis.

A consequence of a dynamical model for nonleptonic decays is investigated. The basis for the model is the assumption that the matrix elements, written in terms of initial state minus final state momenta, are dominated by the low mass mesons in a sense of dispersion theory. In the parity violating amplitudes, this assumption corresponds to the nonleptonic decays being dominated by the $K_1^0 \rightarrow$ vacuum transition. It is shown, however, that the physical amplitudes do not necessarily reflect this forbiddenness. The parity violating nonleptonic hyperon decay amplitudes are fit in this model, and it is shown that it is possible to fit the ratios of the weak decay amplitudes with coupling constants determined solely by the strong interactions. For the parity conserving amplitudes, the existence of a scalar meson (κ) with $|I| = \frac{1}{2}$ and $|Y| = 1$ is assumed. This model leads to a reasonable fitting of the parity conserving nonleptonic hyperon decay amplitudes. This unified picture for the nonleptonic hyperon decays allows predictions of cascade decay parameters which are in reasonable agreement with experiment. In addition, it is shown that the $\Lambda \rightarrow p + \pi^-$ and $\Sigma^+ \rightarrow n + \pi^+$ decay parameters lead to a prediction that $\Sigma^- \rightarrow n + \pi^-$ occur via pure s-wave. Information is also obtained on the baryon-scalar meson octet coupling constants. The model is extended to a discussion of the $K_1 \rightarrow 2\pi$ decay and the K_1, K_2-mass difference. Scalar meson poles would be expected to play a dominant role in such a model. Possible candidates for these scalar mesons are discussed and it is shown that the existence of the nonet scalar meson may have an important bearing on the $|\Delta Y| = 1$ transitions. In particular it is argued that one of the $I = Y = 0$ scalar mesons is preferred to have a mass close to the K-meson (say 510 MeV $< m_\sigma <$ 560 MeV) if one is to have a unified understanding in this model of the $K_1 \rightarrow 2\pi$ rates and of the magnitude and sign of the $K_1 - K_2$ mass difference. Finally, the strong and electromagnetic decays of an $I = 1$, $Y = 0$ meson are discussed. It is shown that an enhancement observed in a $\pi^- + p$ recoil spectrum and not seen in two or three pion final states is a reasonable candidate for a scalar meson with $J^{PG} = 0^+$. (auth)

23325 τ DECAY AND CURRENT ALGEBRA. Vainshtein, A. I.; Dolgov, A. D.; Zakharov, V. I.; Kaidalov, A. B. JETP Lett. (USSR)(Engl. Transl.), 5: 136-9(Mar. 1, 1967).

Translated from Zh. Eksp. Teor. Fiz., Pis'ma Redaktsiyu, 5: 170-3(Mar. 1, 1967).

The consequences of the assumption that the $K \rightarrow 3\pi$ decay amplitude is a constant plus a rapidly varying contribution from the pole diagram are considered. In the physical region the rapid variation is then connected with the strong dependence of the $\pi-\pi$ and $\pi-K$ scattering amplitudes on the momenta, and when the meson (π) momenta tend to zero, allowance for the pole diagrams explains the ambiguity in the calculation of the limit. Within the framework of the model considered the $\Delta T = 1/2$ rule is proven, the probability ratios of the $K \rightarrow 2\pi$ and $K = 3\pi$ decays are obtained, and meson (π) spectra are determined. (J.F.P.)

Strong (General)

23326 (AD-643088) THE QUARK DECOMPOSITION OF HADRON SCATTERING AMPLITUDES. James, P. B.; Watson, H. D. D. (Illinois Univ., Urbana. Dept. of Physics). 1966. Contract N00014-66-C00010-A05. 10p. (NSF-GP-5622). CFSTI $3.00 cy, $0.65 mn.

The quark model of hadrons, combined with the additivity postulate for the quark-quark scattering amplitudes, has had remarkable success in the analysis of high energy scattering data. However in sum rules relating meson-baryon to baryon-baryon total cross sections there exists a large discrepancy with experiment. It is now shown how this discrepancy is removed with careful formulation and application of the additivity postulate. (auth)

23327 (BNL-994, pp 103-10) APPLIED MATHEMATICS. (Brookhaven National Lab., Upton, N. Y.).

The computer operations, engineering activities, and programming of the applied mathematics department are discussed. This discussion includes the Central Scientific Computing Facility, computer scheduling and usage, auxiliary on-line systems, digital transmission links, tape label reader, and the cathode ray tube recorder. Operating systems, hardware diagnostic programs, satellite computers, information storage and retrieval, software for a real-time experiment, and programmed pattern recognition are also considered. Mathematic research is presented including graph theory, differential and integral equations, the plasma model, diophantine inequalities, and numerical analysis. Mathematic statistics, Monte Carlo methods, field theory, and elementary particle theory are also presented. (J.F.P.)

23328 HIGH-ENERGY TWO-BODY REACTIONS IN THE QUARK MODEL. Itzykson, C.; Jacob, M. (Centre d'Etudes Nucleaires, Saclay, France. Service de Physique Theorique, Gif-sur-Yvette, France). Nuovo Cim. (10), 48A: 909-26 (Apr. 21, 1967).

Interest in the quark model is presently being stirred by its many and various applications leading to successful agreements with experiment. High-energy scattering seems to be the field in which the model could be most severely tested. In view of its successful predictions for total cross section ratios, the various complications due to spin and charge are analyzed. They do not require any new assumptions and lead to further predictions of qualitative and quantitative nature. A comparison with present experimental information is made. (auth)

23329 BOUND STATES OF ORDER TWO IN SCATTERING BY A CENTRAL POTENTIAL. Coudray, Christiane; Coz, Marcel (Institut de Physique Nucleaire, Orsay, France). Ann. Inst. Henri Poincare, Sect A, 5: 357-6(1966). (In French).

The possibility of multiple bound states is analyzed in the two following cases: the mixed second derivatives of the Jost solutions exist although they may not be continuous; the Green function of the problem exists. In the first case, the potential is complex; in the second one, the spectral function has δ's. Therefore it cannot correspond to a self-adjoint operator. An example of such a potential is explicitly constructed through an extension of the Gelfand-Levitan methods. (auth)

Strong (Baryon No. = 0)

23330 ESTIMATES OF HIGHER PARTIAL WAVES IN PION-PION SCATTERING. Pisut, J.; Bona, P. (Comenius Univ., Bratislava). Nucl. Phys., B1: 65-78(1967).

The Born approximations for D, F, and G pion-pion phase shifts are calculated on the basis of the Froissart-Gribov representation. The D and F partial waves are calculated also by the method of Hamilton and coworkers. In addition to the f^0, calculations indicate the possibility of resonances in the T = 1, J = 3 and J = 4 partial waves. The T = 2 phase shifts seem also to be larger than usually assumed. (auth)

23331 EXPRESSION FOR THE LINE WIDTH OF MESONS ρ IN THE $N-\bar{N}$ COMPOSITE MODEL. Andriambololona, Raoelina. Ann. Inst. Henri Poincare, Sect. A, 6: No. 1, 73-87(1967). (In French).

An expression for the line width of mesons (ρ) in the case where they are considered as composite particles $N-\bar{N}$ is given. It is shown that in a certain approximation the expression for the line width that is obtained is in good agreement with that which is deduced from the unitarity condition (elastic condition). In the same way it is indicated how one can calculate the line width for mesons (ω) in the same model. (tr-auth)

23332 NUMERICAL STUDY OF THE RELATIVISTIC INFLUENCE ON THE ANGULAR DISTRIBUTION OF A PARTICLE FROM A STATISTICAL-MODEL THREE-BODY DECAY. Proriol, J. (Manhattan Coll., Bronx, N. Y.). Nuovo Cim. (10), 48A: 1051-8(Apr. 21, 1967).

With the conservation of energy, momentum and angular momentum in a statistical model or a three-body decay, it is shown that the shape of the angular distribution of one particle is connected to the energy of the reaction. (auth)

23333 RELATIONS BETWEEN THE INTERACTION CONSTANTS OF σ, f, ρ, AND ω MESONS. Fil'kov, L. V. (Lebedev Inst. of Physics, Moscow). JETP Lett. (USSR) (Engl. Transl.), 5: 153-5(Mar. 15, 1967).

Translated from Zh. Eksp. Teor. Fiz., Pis'ma Redaktsiyu, 5: 192-5(Mar. 15, 1967).

A method for obtaining equations for particle interaction constants is considered. The equations are found by equating two dispersion relations for the amplitude of the investigated process, one of which is written in terms of t and s with fixed u and the other in terms of s and u with fixed t. The method is considered using as an example elastic scattering of γ quanta by mesons (π) and is used to determine the interaction constants of mesons (σ) and (f). (J.F.P.)

23334 CONCERNING THE NATURE OF THE A_1 RESONANCE. Babichev, N. B.; Zhizhin, E. D.; Nikitin, Yu. P. (Moscow Engineering-Physics Inst.). JETP Lett. (USSR)(Engl. Transl.), 5: 162-4(Mar. 15, 1967).

Translated from Zh. Eksp. Teor. Fiz., Pis'ma Redaktsiyu, 5: 202-4(Mar. 15, 1967).

Attention is called to certain specific features of the process of diffraction dissociation on nuclei, the observation of which can serve as an additional argument in favor of the diffraction mechanism for the occurrence of the A_1 peak. It is found that the diffraction mechanism leads to the occurrence of an A_1 peak which does not depend on the energy of the incident meson (π). (J.F.P.)

Strong (Baryon No. = 1)

23335 (AD-644646) ON PION-P CHARGE EXCHANGE POLARIZATION AND THE POSSIBILITY OF A SECOND RHO-MESON. Beaupre, J.; Logan, R. K.; Sertorio, L. (Illinois Univ., Urbana. Dept. of Physics. Iowa State Univ. of Science and Technology, Ames). 1966. Contract N00014-66-C-00010-A05. 16p. CFSTI $3.00 cy, $0.65 mn.

The pion-proton exchange (CEX) reaction, $\pi^- + p \rightarrow \pi^0 + n$ at high energies is a particularly simple reaction from the standpoint of Regge pole phenomenology because only the quantum numbers of the ρ-meson may be exchanged in the crossed channel. It is known that a qualitative explanation of the polarization can be obtained by assuming that an extra term of the differential cross section is due to resonance exchange in the direct channel. Alternative explanations assume that the extra term arises from either a cut, or a second ρ-meson, the ρ. A previous analysis (Phys. Rev. Letters V.: 17, p834 1966) is extended to the more recent 11.2 GeV data and show that the quantitative agreement is improved by the introduction of the ρ. The growing evidence for the existence of a ρ is also reviewed. Consideration is given to the following three models: ρ + resonances, $\rho + \rho$ + resonances, and $\rho + \rho$; their agreement with experiment is compared. The prediction of the three models at different energies is also presented, thus providing an experimental test for distinguishing them. (auth)

23336 MASS SPECTRUM OF THE BARYON EXCITED STATES IN THE STATIC MODEL. Noga, M. (Comenius Univ., Bratislava). Nucl. Phys., B1: 85-95(1967).

It is shown that form factors of strongly interacting particles calculated by the Dashen-Frautschi method in the static model have correct analytical properties. In addition to those if we require the unitarity condition to be fulfilled, relations can be obtained from which the masses and coupling constant ratios can be simply calculated. The results obtained in this way are compared with those obtained by Abers, Balazs and Hara in their bootstrap method and by strong-coupling theory due to Cook, Goebel and Sakita and to Singh. (auth)

23337 A PHENOMENOLOGICAL ANALYSIS OF HIGH-ENERGY DATA IN πA AND KA SYSTEMS: SHADOW SCATTERING AND REGGE SINGULARITIES. Cohen-Tannoudji, G; Morel, A.; Navelet, H. (Centre d'Etudes Nucleaires, Saclay, Gif-sur-Yvette, France). Nuovo Cim. (10), 48A: 1075-1110(Apr. 21, 1967).

A phenomenological model suited for the description of arbitrary two-body reactions at high energies is presented and applied to the analysis of πA, KA, and $\bar{K}A$ scattering. The idea is that the Regge-pole model does not take into account the whole content of the unitarity relation and has to be modified, as is currently done in one-particle exchange models, so that it may include absorptive corrections. In terms of a rather economical set of free parameters, a satisfactory agreement is obtained with all available data, including the recent evidence for a nonvanishing polarization in $\pi^- p \to \pi^0 n$ reaction. The parametrization of the amplitudes is then reinterpreted in terms of poles and branch points in the complex angular-momentum plane for the crossed channel. (auth)

23338 REGGE RECURRENCES AND $\pi-p$ ELASTIC SCATTERING AT HIGH MOMENTUM TRANSFERS. Bialas, A. (Jagellonian Univ., Krakow. CERN, Geneva); Bialas, E.; Czyzewski, O.; Kotanski, A. Nuovo Cim. (10), 48A: 1111-23(Apr. 21, 1967).

The influence of the resonance formation on the high momentum transfer elastic $\pi-p$ scattering is investigated. A new model, in which the known Regge recurrences are extrapolated to higher energies, is proposed. It is shown that the model can account for the present data on the $\pi-p$ elastic scattering at high momentum transfers. Some implications of such a mechanism are discussed. (auth)

23339 PIONIC PRODUCTION OF THE ETA MESON. Srinivasan, S. K.; Achuthan, P. (Indian Inst. of Tech., Madras). Nuovo Cim. (10), 48A: 1124-36(Apr. 21, 1967).

The production of the eta meson in pion-nucleon collisions is studied by dispersion-theoretic techniques. Differential and total cross sections for various ranges of energy and angles are tabulated and compared with the experimental results. (auth)

23340 MODEL FOR HIGH-ENERGY INELASTIC PROCESSES. Predazzi, E. (Univ. of Chicago). Nuovo Cim. (10), 48A: 1014-40(Apr. 21, 1967). (COO-264-334; EFINS-66-72).

The problem of expressing the high-energy inelastic amplitudes in terms of the elastic amplitudes that couple through unitarity is discussed. A solution to this problem is given by approximately solving the unitarity equations with assumptions similar to the ones usually made in the absorptive model, together with a high-energy factorization property. The surprising result is obtained that the inelastic amplitudes are completely expressible in terms of all the elastic ones that have the correct quantum numbers to couple through unitarity. Some general properties of this solution are investigated for $\pi^- p$ and $K^- p$ charge exchange by using an exact Fourier–Bessel representation which is derived by means of techniques previously developed. Similarly to what happens in the Byers and Yang droplet model, the high-energy inelastic amplitudes in the forward direction show an exponentially decreasing peak (as function of the momentum transfer), if this is present in at least one of the elastic (initial and final) channels. The question of whether the forward peak of the inelastic amplitude is narrower or wider or comparable to the elastic one is seen to require a very detailed parametrization of the elastic data. In principle, in the model, there are no arbitrary parameters left since the inelastic amplitudes are completely determined from the knowledge of all the elastic ones. In practice, however, the limitation of experimental information at one's disposal forces the introduction of an empirical energy-dependent factor. Within the framework of the model, little can be said about this energy-dependent factor. If, however, one makes the extra assumption that all the elastic channels are comparably equal and that the number of channels open at a given (high) energy have the same energy dependence as the multiplicity, then it can be seen that very good agreement is obtained, in this approximation, for $\pi^- p \to \pi^0 n$ which is the only case for which sufficiently large statistics exists. No detailed numerical comparison of the theory with experimental data is attempted. (auth)

23341 PION–NUCLEON COLLISIONS AND SINGLE-PION PRODUCTION. Gleeson, A. M. (Syracuse Univ., N. Y. Univ. of Pennsylvania, Philadelphia); Mahanthappa, K. T. Nuovo Cim. (10), 48A: 849-89(Apr. 21, 1967).

In this treatment of pion-nucleon collision and single-pion production, the requirements of unitarity are studied and its effects on the analytic structure of the production amplitude described. This is done by first carefully defining the physical amplitudes in the three-body helicity formalism. These amplitudes are then substituted into the unitarity equation and this unitarity equation is separated into a system of discontinuity equations. Also the effects of possible driving terms are studied. All this formalism is used to formulate a model of the production process. (auth)

23342 THE N*(3,3) RESONANCE IN MULTICHANNEL SCATTERING. Brunet, R. C. (Argonne National Lab., Ill.); Childers, R. W. Nuovo Cim. (10), 48A: 890-908(Apr. 21, 1967).

The $I = \frac{3}{2}$, $J = \frac{3}{2}$ p-waves of the following unitarily coupled processes: $\pi A \to \pi A$, $\pi A \to \pi A^*$, $\pi A^* \to \pi A$ and $\pi A^* \to \pi A^*$ are examined. The Born terms for a one-nucleon exchange in the u-channel are calculated in a relativistic way, and a multichannel N/D calculation is performed for the amplitude matrix. The dispersion relations are written for modified partial-wave amplitudes to ensure correct threshold behavior, MacDowell symmetry and asymptotic limit. No cut-off is used in this one-nucleon exchange model. It is found that both the $\pi A \to \pi A$ and the $\pi A^* \to \pi A^*$ considered separately can produce a bound state. The channels are then coupled and a self-consistent value for the $g_{\pi A A^*}$ is required. The width and the position of the original $\pi A \to \pi A$ resonance move closer to the experimental value of the $A^*(3,3)$. This requirement, however, causes the $\pi A^* \to \pi A^*$ resonance to move to an energy lower than the $A^*(3,3)$. Although only weakly coupled to the πA channel this low-lying bound state is a serious ambiguity. (auth)

Strong (Baryon No. ≥ 2)

23343 DEUTERON/SINGLET DEUTERON PRODUCTION IN $p + p \to p + n + \pi$. Duck, Ian (Rice Univ., Houston, Tex.). Nucl. Phys., B1: 96-104(1967). (ORO-1316-13).

The forward cross section for deuteron production in proton-proton collisions at a bombarding energy of 2.4 GeV is large compared to that for singlet deuteron production. This fact is shown to favor the one-pion-exchange model for this reaction over the one-neutron-exchange model, which leads to too large a singlet deuteron cross section. (auth)

23344 SPIN OF THE f^0 FROM $\pi^+ d$ INTERACTIONS AT 6 GeV/c. de Rosny, G.; Fleury, P. (Ecole Polytechnique, Paris). Nuovo Cim. (10), 48A: 1137-41(Apr. 21, 1967).

An attempt is made to combine two approaches, the analysis of $\pi^+\pi^-$ angular decay distribution and the comparison of the production cross section with an estimation of the unitary limit, through an interpretation of $\pi^+ d$ data in terms of $\pi\pi$ scattering, for the determination of the f^0 spin. From 70,000 pictures obtained from π^+ interactions at 6.0 GeV/c in a deuterium-filled bubble chamber 639 interactions $\pi^+ + d \to p + p + \pi^+ + \pi^-$ and 388 $\pi^+ + d \to p + p + x^0$ interactions were isolated. The angular decay distribution of the f^0 and spherical harmonic components of the f^0 disintegration are given. (J.F.P.)

23345 TRANSVERSE MOMENTA OF LEADING PARTICLES IN NUCLEON–NUCLEON INTERACTIONS WITH ENERGIES 10^{12} TO 10^{14} eV. Rybicki, K. (Inst. of Nuclear Research, Krakow). JETP Lett. (USSR)(Engl. Transl.), 5: 130-3(Mar. 1, 1967).

Translated from Zh. Eksp. Teor. Fiz., Pis'ma Redaktsiyu, 5: 162-6(Mar. 1, 1967).

Results concerning leading particles in nucleon–nucleon interactions in the range 10^{12} to 10^{14} eV, with a leading particle defined as the particle that carries away the maximum energy, are discussed briefly. These interactions were obtained in two large emulsion blocks in ICEF and Brawley. There were 24 events with $N_h \leq 5$ and $n_s \leq 20$ chosen. Distributions of secondary-particle to primary-particle energy, and of the transverse momenta of leading particles are given. (J.F.P.)

Particle Invariance Principles and Symmetries

General

Refer also to abstract 23315.

23346 (JINR-E02-3196) DIVERGENCES OF VECTOR AND AXIAL-VECTOR CURRENTS IN STRONG INTERACTION. Montvay, I. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Theoretical Physics). 1967. 11p. Dep. mn.

Models for the SU(3) × SU(3) breaking part of strong interactions are considered. The divergence of vector and axial-vector currents is given explicitly. It is argued that the hypothesis of Pole Dominated Divergence of Axial-vector Current (PDDAC) can be maintained as an approximately valid dynamical consequence of the strong interactions, independently of the form of the divergence condition for the axial-vector current. As an application the meson photoproduction near threshold is considered taking into account the SU(3) breaking. (auth)

23347 SYMMETRY, SUPERCONVERGENCE, AND SUM RULES FOR SPECTRAL FUNCTIONS. Das, T.; Mathur, V. S.;

Okubo, S. (Univ. of Rochester, N. Y.). Phys. Rev. Lett., 18: 761-4(May 1, 1967).

The convergence and the superconvergence properties of the invariant amplitudes which occur in suitable combinations of the propagator functions of the vector and the axial-vector currents are discussed based on the use of symmetry arguments for the asymptotic behavior. The sum rules so obtained for the spectral functions are in good agreement with experiment. (auth)

23348 MICROCAUSALITY AND THE REPRESENTATIONS OF SELF-CONJUGATE BOSONS. Fleming, Gordon N.; Kazes, E. (Pennsylvania State Univ., University Park). Phys. Rev. Lett., 18: 764-6(May 1, 1967).

A generalization of the Carruthers theorem, which states that self-conjugate spinless bosons comprising spinorial (even number of dimensions) representations of the isospin group are the quanta of fields which do not commute for spacelike separation, is found in which the dependence of the argument on canonical quantization and the restriction to free fields is removed. Furthermore, the results can be stated in a manner immediately applicable to arbitrary internal symmetry groups, and it is indicated how the generalization to higher (integral) mechanical spin can be made. (J.F.P.)

23349 THE SU(6) MODEL AND ITS RELATIVISTIC GENERALIZATIONS. Ruegg, H. (International Center for Theoretical Physics, Trieste, Italy. CERN, Geneva); Ruehl, W.; Santhanam, T. S. Helv. Phys. Acta, 40: 9-134(1967).

A critical discussion of the ideas involved in the SU(6) symmetry models is presented. The main emphasis is laid upon the relativistic extensions of SU(6) symmetry. The relativistic extensions are aimed to apply to all phenomena of strong interaction physics (bound states excluded) and even to electromagnetic and weak interactions in first order after a proper definition of spurions. Since the discussion of SU(6) symmetries started, the belief has persistently been expressed that such relativistic models cannot be defined consistently. Indeed, the discussion of difficulties encountered in the relativistic models can be looked upon as one of the purposes of this discussion. Such difficulties are the conflict with unitarity or crossing symmetry of the S-matrix. But this criticism does not exhaust the presentation of these models. It is believed that the studies of relativistic extensions have well entailed a positive result: the invention and the exploration of the collinear and coplanar subgroup symmetries. These groups are a priori not in conflict with any known principle imposed on the S-matrix. At least as the collinear group S[U(3) ⊗ U(3)] is concerned the predictions are throughout in excellent agreement with experiment (with exception of the cases where SU(3) itself is already a bad symmetry). The material is presented as follows. The physical ideas and the mathematical basis involved in the different models are developed. The subgroup symmetries are applied systematically to the most important physical problems. The results are written in terms of observable amplitudes and not in terms of SU(3) invariants only. Some tables of decompositions of representations are given. The current algebra approach is not considered. (J.F.P.)

Applications (Strong)

23350 VARIATIONAL TREATMENT OF THE NONPERTURBATIVE TRION DYNAMICS. Ladanyi, K. (Research Group for Theoretical Physics, Budapest). Nuovo Cim. (10), 48A: 927-62(Apr. 21, 1967).

The dynamical properties of the trion model are discussed starting with a nonlinear spinor equation, which is form-invariant under the transformations of the SO_6-group. Exact SO_6-covariance is assumed and the Bethe–Salpeter equations of the trion-antitrion and trion-trion two-point amplitudes are considered in a ladderlike approximation. The interaction kernel contains the contributions of vector bosons and pseudoscalar bosons with derivative coupling. The two-point amplitudes have to satisfy simple boundary conditions for vanishing relative co-ordinates, which are obtained by requiring the existence of the local nonlinear interaction term of the underlying field equation. These boundary conditions may be satisfied only for fixed values of the "bare" coupling constants of the coupling of trions to trion-antitrion pairs characterized by spin zero and one and representations 1, 15 and 20′′ of SO_6. All these coupling constants are different from zero and given explicitly. The higher internal symmetry is necessary in order to obtain consistent results. A generalization of the results by taking into account the spontaneous breakdown of the SO_6-symmetry is given. The effective-mass operator and the generalized form factors of trions are defined as the solutions of a variational problem resulting from the requirement of the maximal convergence of higher approximations. A generalized ladder approximation is obtained for the two- and six-point amplitudes corresponding to trion systems. The effective-trion mass operator and the generalized trion form factors may strongly depend on the state assignments of the trion systems. The possibility of the dynamical origin of all internal symmetries is discussed. (auth)

23351 PHENOMENOLOGICAL QUARK–ANTIQUARK POTENTIAL. Halzen, F. (Univ. of Louvain, Belg.). Nuovo Cim. (10), 48A: 1142-7(Apr. 21, 1967).

The different terms in a phenomenological Hamiltonian are fixed more precisely. This Hamiltonian is different from the one assumed previously in order to allow an increase of the information that can be extracted from the experiments. The different parameters, including a spin-spin, spin-orbit, and tensor term, are computed. Also a strict relation between the mass of the quark and the range of the potential is found, and the nonrelativistic character of the internal motion in the compound model is confirmed even for excited L states. (J.F.P.)

23352 RESONANCE DECAYS FROM O(3,1)DYNAMICS. A REGULARITY IN THE PARTIAL DECAY WIDTHS. Barut, A. O.; Kleinert, Hagen (Univ. of Colorado, Boulder). Phys. Rev. Lett., 18: 754-6(May 1, 1967).

The scalar form factors in an irreducible representation of the noncompact group O(3,1) containing antiparticles is evaluated in closed form. In particular, the decay of baryon resonances into the ground state is evaluated and compared with experiment. (auth)

Quantum Field Theories

23353 QUANTUM ELECTRODYNAMICS WITH MAGNETIC MONOPOLE. Tevikyan, R. V. (Inst. of Physics, Erevan). Nucl. Phys., B1: 79-84(1967).

A Lagrange function of quantum electrodynamics with magnetic monopole is suggested. (auth)

23354 INTEGRAL EQUATIONS OF THE KALLEN–PAULI TYPE IN THE QUANTIZED FIELD THEORY. Gostev, V. B.; Frenkin, A. R. Izv. Akad. Nauk Arm. SSR, Ser. Fiz., 1: 329-39 (1966). (In Russian).

The Källen–Pauli integral equation:

$$\psi(\omega) = \varphi(\omega) - \frac{1}{\pi}\int_1^\infty \frac{d\omega'\psi(\omega')\ \mathrm{Im}\ h(\omega')}{h(\omega_0 - \omega')(\omega' + \omega - \omega_0)}$$

found in problems connected with quantized field theory can be solved using an integral representation of $\psi(\omega)$ through 0 function $\alpha(\omega)$ which has no cuts on the real axis. Expressions for $\psi(\omega)$ were obtained in the final form in cases of homogenous equations with polynomial and polar inhomogenous terms. Possible generalizations are indicated. (auth)

23355 REINTERPRETATION OF THE NOTION OF LOCALIZATION. Kalnay, A. J.; Toledo, B. P. (Univ. Nacional, Cordoba, Argentina). Nuovo Cim. (10), 48A: 997-1007(Apr. 21, 1967).

Several reasons suggest that the difficulties to obtain the position operator in relativistic quantum mechanics are caused by the hypothesis that the measurable values of a component of the position are real numbers instead of regions of space of the order of a Compton wave length. It is shown how to develop the idea by using nonnormal operators and prove that this is consistent with reasonable requirements of position. The use of non-Hermitian and nonnormal operators in quantum mechanics is discussed. (auth)

23356 PUNCTUAL APPROXIMATIONS TO THE EXTENDED TYPE POSITION. Gallardo, J. A.; Kalnay, A. J.; Stec, B. A.; Toledo, B. P. (Univ. Nacional, Cordoba, Argentina). Nuovo Cim. (10), 48A: 1008-13(Apr. 21, 1967).

It is proved that an extended-type position operator previously defined has a correct relation with the known point-type position operators. (auth)

Scattering Theory

23357 ITERATION METHOD IN MULTIPLE SCATTERING. Borovoi, A. G. (Siberian Physical-Technical Inst., Tomsk, USSR). Izv. Vyssh. Ucheb. Zaved., Fiz., No. 6, 50-4(1966). (In Russian).

An iteration method was used in order to obtain a transfer equation for electromagnetic wave scattering in a system of a large number of statistically independent spherically shaped particles under a condition in which $c/k^{-1} \ll 1$, c is the particle density number, σ is the scattering cross section of a single particle, and k is the wave number. The method was also used

for the mathematical analysis of the scalar wave scattering and wave scattering in arbitrary shaped particle system. (R.V.J.)

23358 THRESHOLD BEHAVIOR OF 3-BODY PARTIAL-WAVE AMPLITUDES. II. Halliday, I. G. (Princeton Univ., N. J.). Nuovo Cim. (10), 48A: 982-96(Apr. 21, 1967).

The threshold behaviour of 3-body production processes is examined in potential theory. A decomposition into states with total angular momentum J and component M along a body-fixed axis is used. All possible limits for the momenta p_i of the final-state particles going to zero are treated in detail. Due to an unnoticed identity previous results are altered. Also treated are the non-leading terms. (auth)

Particle Accelerators

Refer also to abstracts 22085, 22220, and 22221.

23359 (ANL-7273) ON THE SHIELDING OF THE EXTERNAL PROTON TUNNEL AREA OF ARGONNE'S ZERO GRADIENT SYNCHROTRON. Howe, H. J. Jr., Oldfield, G. V.; Sreniawski, D. J.; Wheeler, R. V. (Argonne National Lab., Ill.). Nov. 1966. Contract W-31-109-eng-38. 22p. Dep. CFSTI.

An experimental evaluation of the radiation levels in the area of the external proton tunnel (EPT) of the Argonne Zero Gradient Synchrotron (ZGS) under conditions of thick-target bombardment by approximately 2×10^{10} protons/sec has been completed. The radiation levels in the forward hemisphere from the target varied linearly with target thickness, and the maximum levels were observed between 60 and 70° from the incident beam direction. A reduction of radiation levels noted at smaller angles ($\theta < 40°$) is attributed to the longer path length of shield materials traversed by secondaries emitted into the forward direction. A similar reduction of radiation levels observed at large angles ($\theta > 75°$) is attributed to the smaller number of high-energy secondaries emitted from the target into these directions. The dependence of the radiation levels on distance from the shield wall was found to consist of an area of rapid decrease (approximately as $1/r^2$) followed by an area of less rapid decline (approximately as $1/r$). Measurements of the stray radiation field with tissue-equivalent (TE) ionization chambers in normally occupied areas indicated absorbed dose levels of 0.2 to 0.8 mrad/hr with a 0.5-in. copper target and 0.3 to 3.0 mrad/hr with a 5.0-in. copper target. With an effective quality factor ($\overline{QF}$) of 5, determined from experimental linear energy transfer (LET) spectral measurements, these measurements yield dose equivalent rates (DE) from 1.0 to 4.0 mrem/hr with the 0.5-in. target and from 1.5 to 15.0 mrem/hr with the 5.0-in. target. Hence, it was necessary to revise the shielding configuration to obtain more effective attenuation without a significant reduction of experimental space. By means of a simple exponential attenuation model, the data were used to obtain estimates of the attenuation lengths λ_s and λ_c for steel and concrete, respectively. These estimates: $\lambda_s = 142 + 15$ g/cm^2 ($\rho = 7.85$ g/cm^3) and $\lambda_c = 173 \pm 18$ g/cm^2 ($\rho = 3.8$ g/cm^3), are in fair agreement with previously published results. Since accurate and reliable shielding calculations depend on the accuracy of these parameters, a more extensive evaluation of the shielding properties of ordinary concrete, high-density concrete, and steel is planned for the purpose of obtaining definitive values of λ_s and λ_c for the ZGS shielding materials. (auth)

23360 (BNL-994, pp 20-36) HIGH ENERGY ACCELERATORS. (Brookhaven National Lab., Upton, N. Y.).

The accelerator program at Brookhaven is reviewed. Topics discussed are operation, technical development, engineering programs, experimental planning, support activities, and accelerator studies associated with the AGS. Advanced accelerator development for a 600 to 1000 GeV synchrotron is briefly outlined. (B.G.D.)

23361 (BNL-11287) STEM PERTURBATIONS OF THE RESONANT FREQUENCY IN A 200-MeV LINAC. Jellett, K.; Parzen, G. (Brookhaven National Lab., Upton, N. Y.). Mar. 27, 1967. Contract AT(30-2)-Gen-16. 5p. Dep. mn. CFSTI $3.00 cy, $0.65 mn.

The shift in the resonant frequency of a linac cell due to the stems that support the drift tubes is computed. The frequency shift was computed using the perturbation theory result $(\Delta F/f) = -\frac{1}{2}[(1/Z_0^2)\int E^2 dV - \int H_z dV]/\int H^2 dV$, where the integrals in the numerator are done over the volume of the stems, and the integral in the denominator is done over the entire volume of the cell. E and H are the electromagnetic fields in the absence of the stems. (B.G.D.)

23362 (CEAL-1035) A PROPOSED SYSTEM FOR MULTI-CYCLE INJECTION OF POSITRONS AND ELECTRONS INTO THE 6 GeV CAMBRIDGE ELECTRON ACCELERATOR. Robinson, K. W.; Sherwood, T. R.; Voss, G. A. (Cambridge Electron Accelerator, Mass.). Mar. 7, 1967. Contract AT(30-1)-2076. 15p. (CONF-670307-33). Dep. mn. CFSTI $3.00 cy, $0.65 mn.

From National Particle Accelerator Conference, Washington, D. C.

The design of a system for accumulating counter-rotating beams of positrons and electrons, up to 0.1 A, in the CEA ring is discussed. Beams of this intensity are required if the CEA is to be used successfully as a colliding beam facility. Repeated, single turn, off-axis injection will be used at a repetition rate of 60 c/s. After each injection at 135 MeV, all particles will be accelerated to an energy in the 2 to 3 GeV range and then decelerated back to the injection energy. During the cycle, sufficient radiation damping of betatron and synchrotron oscillations is achieved to allow more particles to be injected without losing a large fraction of the particles injected in preceding cycles. Incoming particles are inflected by a septum magnet located off the equilibrium orbit while the path of the circulating beam is displaced towards the septum throughout the interval required for single turn injection. The current that can be accumulated depends on the number of particles injected per cycle and the lifetime of the circulating beam. Injection of a positron beam is more difficult than injection of an electron beam because of the smaller current and larger emittance associated with the source. When the horizontal phase space is used for injection, the half-life of the circulating beam is estimated to be 90 sec. if the average gas pressure is 5×10^{-9} torr. The positron source is expected to deliver 0.4 mA with an energy spread of 2.5 MeV and an emittance of $(2.5\ \pi$ mrad. cm$)^2$. We expect to be able to inject 0.1 mA of this current each cycle and have a considerable margin for error in arriving at our design estimate of 100 mA. (auth)

23363 (CEAL-TM-155) NOTES ON THE DAMPING SYSTEM FOR THE CEA BYPASS. Robinson, K. W.; Voss, G. A. (Cambridge Electron Accelerator, Mass.). Dec. 10, 1965. Contract AT(30-1)-2076. 10p. Dep. mn. CFSTI $3.00 cy, $0.65 mn.

The operation of the damping system for the CEA bypass is discussed. Topics include dc operation, radiation losses, bending and focusing effects of the magnet and ac operation. (B.G.D.)

23364 (DESY-67/5) PARTICLE LOSS BY TOUSCHEK EFFECT IN A STORAGE RING. Voelkel, Uta (Deutsches Elektronen-Synchrotron, Hamburg (West Germany)). Mar. 1967. 18p. Dep. mn.

A formula for the loss rate of electrons from a stored beam due to the so-called Touschek Effect is derived starting with the exact Moeller scattering cross section. For rectangular distribution of transverse momentum, this formula is integrated explicitly. For gaussian distribution it is expanded in a series of $1/\delta q$ (rms of transverse momentum), which is computed for $0.3 \leq \delta q \leq 10$ (in $m_0 c$). The difference between both distributions in this region turns out to be less than 1%, so that the explicit formula for rectangular distribution can be used for all practical purposes. (auth)

23365 (IPP-2/58) EIN KLEINER BESCHLEUNIGER FUER LEICHTE IONEN MIT UHV IN DER TARGETKAMMER. (A Small Accelerator for Light Ions With UHV in the Target Chamber). Behrisch, R. (Institut fuer Plasmaphysik, G.m.b.H., Garching (West Germany)). Feb. 1967. 14p. (In German). Dep. mn.

A small accelerator for light ions was constructed. It gives a constant ion beam of 0.5 to 1.5 mA H^+ focused to a diameter of about 5 mm. The acceleration voltage is adjustable between 50 and 150 kV. The ions are extracted from a rf ion source, accelerated to two stages to the full energy and mass separated by a magnetic sector field. The vacuum system comprises three pumping units. In the target chamber, which can be baked out up to 450°C, a residual gas pressure of $<10^{-9}$ torr can be attained. The operating pressure depends on the intensity of the ion beam and is in the range 10^{-7} to 10^{-8} torr H_2. (auth)

23366 (JINR-P09-3181) FORMIROVANIE MAGNITNOGO POLYA V TSENTRAL'NOI OBLASTI SINKHROTSIKLOTRONA S TSEL'YA UVELICHENIYA VERTINKAL'NOI FOKUSIROVKI. (Formation of the Magnetic Field in the Central Region of the Synchrocyclotron to Increase Vertical Focusing). Danilov, V. I.; Mukhina, V. B.; Safonov, A. N. (Joint Inst. for Nuclear Research, Dubna (USSR), Lab. of Nuclear Problems). 1967. 21p. (In Russian). Dep. mn.

Some variants are considered on how to improve the vertical focusing of particles by formation of axially symmetrical magnetic fields with a large drop-off in the central region of the synchrocyclotron as well as by creation of an azimuthally varying magnetic field. It is shown that the use of a magnetic field variation near the center to increase the vertical focusing without considerable diminution of the dee aperture is not advisable, since one does not succeed in providing a sufficiently great variation amplitude at small radii. (auth)

23367 (SLAC-71) TWO-MILE ACCELERATOR PROJECT. Quarterly Status Report, July 1-September 30, 1966. (Stanford Linear Accelerator Center, Calif.). Mar. 1967. Contracts AT(04-3)-400; AT(04-3)-515. 99p. Dep. mn. CFSTI $3.00 cy, $0.65 mn.

A report is presented on the Stanford Linear Accelerator Center during July 1, 1966 to September 30, 1966. Topics include the physical plant, accelerator physics, instrumentation and control, electronics, klystrons, accelerator operations, research area, and preoperations research and development. (B.G.D.)

23368 (UCRL-17222) CHOICE OF THE INJECTOR SYSTEM FOR THE 200-GeV ACCELERATOR. Peterson, Jack M. (California Univ., Berkeley. Lawrence Radiation Lab.). Feb. 27, 1967. Contract W-7405-eng-48. 7p. (CONF-670307-32). Dep. mn. CFSTI $3.00 cy, $0.65 mn.

From National Particle Accelerator Conference, Washington, D. C.

Many different types of injection systems are possible for the 200-BeV accelerator. A single-stage, single ring, 8-BeV fast booster is the best choice. (auth)

23369 (UCRL-17246) FAST KICKER MAGNETS FOR THE 200 GeV ACCELERATOR. Faltens, Andris; Giesch, Manfred (California Univ., Berkeley. Lawrence Radiation Lab.). Jan. 30, 1967. Contract W-7405-eng-48. 9p. (CONF-670307-30). Dep. mn. CFSTI $3.00 cy, $0.65 mn.

From National Particle Accelerator Conference, Washington, D. C.

Several fast-transfer systems using kicker magnets are needed for the proposed 200-GeV Accelerator. A possible system for transfer from the injector synchrotron to the main ring using stationary, full-aperture kicker magnets presents the most stringent requirements. The extraction kicker for the injector synchrotron will be about 4 m in length, have a 4-by-14-cm aperture, and require a field of 300 G. For 100% efficient transfer the rise time of the magnetic field must be shorter than 17 ns, which is the time between beam bunches, and which is nearly an order of magnitude less than the rise times achieved in existing kicker magnets. Because of the required rise time and the limited length, each magnet is divided into 48 modules operated as 24 push-pull pairs. Each module is analyzed as a short-circuited ferrite-and dielectric-loaded transmission line. The short-circuited mode of operation ensures that voltage on the magnet is applied for only about 12 ns, thus reducing HV problems, and at the same time produces a kick twice as great as can be obtained from terminated magnets. Each module is energized by a tapered coaxial pulse line and switched on with a triggered spark gap. (auth)

23370 (UCRL-17252) EXPERIMENTAL STUDIES OF THE OMNITRON ELECTRICAL COMPONENTS. Davis, James W.; Gagnon, William L.; Smith, Bob H. (California Univ., Berkeley. Lawrence Radiation Lab.). Feb. 3, 1967. Contract W-7405-eng-48. 12p. (CONF-670307-29). Dep. mn. CFSTI $3.00 cy, $0.65 mn.

From National Particle Accelerator Conference, Washington, D. C.

A prototype resonator has been built and is under study. It tunes from 6.8 to 33 MHz and is designed to produce an accelerating gap voltage of 60 kV at 20 Mc. Sixty 30-in.-diam by ½-in.-thick ferrite discs are used. The resonator is excited by a final amplifier using an RCA 4616 tube designed to deliver a peak RF power of 300 kW. Studies of the RF drive train and the master oscillator, which tunes continuously from 1.5 to 33 MHz are also discussed. It is a beat-frequency oscillator using a crystal-controlled fixed oscillator and a varactor-tuned variable oscillator. A ferrite magnet system, also under study, contains a coaxial, lumped-constant pulse line with a hydrogen thyratron switch tube coupled to a ferrite magnet. The pulse line uses ceramic capacitors and operates at one atmosphere of SF_6. The rise time is 100 ns, the pulse width 5 μsec, and the repetition rate 60 pps. Peak instantaneous power during the pulse is 200 MW; average power is 65 kW. (auth)

23371 (UCRL-17275) A NEW HYDRODYNAMIC LIQUID COOLING METHOD FOR EDGE-COOLED, FLAT CONDUCTOR MAGNET COILS AND FOR LIQUID-COOLED FERRITE RF RESONATOR DISCS. Dorward, John G. (California Univ., Berkeley. Lawrence Radiation Lab.). Feb. 22, 1967. Contract W-7405-eng-48. 7p. (CONF-670307-35). Dep. mn. CFSTI $3.00 cy, $0.65 mn.

From National Particle Accelerator Conference, Washington, D. C.

A method of efficiently cooling tape-wound, edge-cooled magnet coils, or ferrite discs results from the action of an inwardly-directed spiral free vortex flow pattern of the coolant. Many of the unfavorable hydraulic losses and heat-transfer limitations inherent in conventional internally-cooled magnet coils can be eliminated or minimized. The designer can independently control fluid velocities, turbulence, heat-transfer rate, fluid flow rate, bulk temperature rise, and coil space factor within wide limits by the use of hydrodynamic techniques. Hydraulic pumping energy can be minimized, conductor temperature rise can be reduced, and in many cases, the electrical current density in the conductors can be raised by the use of external vortex coolant flow. The radial increase of fluid velocity toward the center matches the need for improved cooling of the inner portions of RF ferrite discs resulting from the increased heating at the inner rim. This reduces the hazard of thermal fracture in the brittle ferrite due to differential heating. (auth)

23372 (UCRL-17457) DEVELOPMENT OF 2000-AMPERE DIODES FOR HIGH CURRENT FERRITE BIASING SUPPLIES. Tusting, R. F.; Katz, J. E.; Kerns, Q. A. (California Univ., Berkeley. Lawrence Radiation Lab.). Mar. 17, 1967. Contract W-7405-eng-48. 15p. (CONF-670307-34). Dep. mn. CFSTI $3.00 cy, $0.65 mn.

From National Particle Accelerator Conference, Washington, D. C.

Ferrite tuning circuits of the rf system for the 200-GeV machine require specialized components, because of the requirements for high current and for reliability under pulsing conditions. The present status of the LRL program to provide high-current supplies for ferrite biasing is described. (auth)

23373 PROBLEMS OF VOIDS IN CERN INTERSECTING STORAGE RINGS. Angerth, B.; Calder, R.; Fischer, E.; Wikberg, T. (CERN, Geneva). Vide, 21: 477-81(Nov.-Dec. 1966). (In French).

Construction of the CERN Intersecting Storage Rings has started. The rings are expected to begin operating during 1971. They will permit proton-proton collision experiments with the existing 28 GeV CERN synchrotron using colliding beam technique. Corresponding experiments using one beam and a stationary target would require a 1.7 TeV accelerator. The high beam intensities needed for colliding beam experiments are obtained by accumulation of many hundred particle pulses from the accelerator giving beam intensities of about 20 A. The stored beam lifetime must be of the order of a day calling for an average pressure in the beam chamber not higher than 10^{-9} torr (nitrogen equivalent). To get a sufficiently low background scattering a pressure of 10^{-11} torr is required for the colliding beam regions. Pumping outside the colliding beam regions will be achieved by 240 sputter-ion pumps possibly combined with titanium sublimation pumps. Inside some of these regions liquid helium cooled cryopumps will be used. About 500 Bayard-Alpert or cold cathode type gauges will be employed to survey total pressure, pump performance and leaks. For gas analysis 24 residual gas analysers will be needed. The 2,000 m of stainless steel vacuum chamber tubing must be baked to 300°C. Some 5,000 demountable seals will be included. To facilitate maintenance and modification work the vacuum system is to be subdivided into 24 independent vacuum sectors by means of special straight through valves capable of being baked in closed position. (auth)

23374 SLAC: THE ACCELERATOR. Neal, Richard B. (Stanford Linear Accelerator Center, Calif.). Contract AT(04-3)-400. Phys. Today, 20: No. 4, 27-9; 31-2; 34; 36-9; 41(Apr. 1967). (SLAC-PUB-233).

A general description is presented on the Stanford Linear Accelerator which includes details on the accelerator structure, klystrons, drive and phasing system, high-power modulators, injector system, positron source, guidance and diagnosis, trigger system, alignment system, and beam switchyard. An evaluation of the operating results concerned with energy gain, energy spectra, electron bunching, phasing, beam transmission, and beam pickup is also presented. (B.G.D.)

23375 SLAC: THE PROGRAM. Ballam, Joseph (Stanford Linear Accelerator Center, Calif.). Phys. Today, 20: No. 4, 43-6; 49-50; 52(Apr. 1967).

The experimental apparatus, special beams, and experimental program at Stanford Linear Accelerator Center are described. (B.G.D.)

23376 THE LARGE LINEAR ACCELERATOR OF STANFORD. Sorger, Michel. Sci. Progr.-Nature, No. 3383, 99-102 (Mar. 1967). (In French).

A brief description is given of the 20-BeV Stanford linear accelerator. Its principal characteristics and performances are tabulated. (J.S.R.)

23377 STUDY OF STRONG FOCUSING DEVICES FOR HIGH CURRENT ELECTROSTATIC ACCELERATORS. Burnot, Guy (Institut de Physique Nucleaire, Lyon. Faculte des Sciences, Villeurbanne, France). Compt. Rend., Ser. B, 264: 715-18 (Feb. 27, 1967). (In French).

With the use of a special mounting and by using high magnetic

fields, the systems permitting the focusing of beams with intensity from 50 to 100 mA were defined. (tr-auth)

23378 PARTICLE LOSS IN CYCLIC ACCELERATORS IN NONLINEAR RESONANCE AND FINE PARAMETRIC RESONANCE. Zenkevich, P. R. (Inst. of Theoretical and Experimental Physics, Moscow). Prib. Tekh. Eksp., No. 1, 24-30 (Jan.-Feb. 1967). (In Russian).

By means of the Fokker–Planck equation particle losses in cyclotrons and storage rings, produced by a stochastic increase of the amplitude of the oscillations during intersection of the fine resonance, was calculated. The stabilizing effect of attenuation was taken into account in the calculations. On the basis of the development of the theory, particle losses during Coulomb intersection of the fine parametric resonance of the betatron oscillations, the losses in the parametric resonance of the phase oscillations, and the nonlinear resonance of the betatron oscillations were calculated. The results of the loss in nonlinear betatron resonance of the third series were compared with measurements carried out on the proton synchrotron ITEF. (tr-auth)

23379 NONLINEAR RESONANCES IN FLUCTUATIONS OF THE QUADRATIC NONLINEARITY OF THE MAGNETIC FIELD IN THE PROTRON SYNCHROTRON ITEF. Zenkevich, P. R.; Gol'din, L. L.; Talyzin, A. N.; Nikolaev, V. I.; Barabash, L. Z.; Pligin, Yu. S. (Inst. of Theoretical and Experimental Physics, Moscow). Prib. Tekh. Eksp., No. 1, 30-4(Jan.-Feb. 1967). (In Russian).

In the proton synchrotron ITEF the nonlinear resonances in the fluctuations of the quadratic nonlinearity essentially effect the capture of particles in the acceleration regime and limit the range of the permissible betatron frequency in all acceleration cycles. These resonances were experimentally studied by means of special coils making it possible to create resonances of the harmonics of the quadratic nonlinearity. The dependence of the loss in the nonlinear resonance on the amplitude of the resonance harmonics, on the betatron frequency at the moment of injection, and on the current of the injected particles was investigated. The size of the fluctuation of the quadratic nonlinearity, caused by defects of the neutral magnetic pole, was evaluated. (tr-auth)

23380 APPROXIMATION METHOD FOR THE CALCULATION OF MAGNETIC LENS SYSTEMS FOR PARTICLE FOCUSING. Maikov, E. V.; Miller, V. V. (Joint Inst. for Nuclear Research, Dubna, USSR). Prib. Tekh. Eksp., No. 1, 34-7(Jan.-Feb. 1967). (In Russian).

The matrices describing the effect of systems (doublet and triplet) of quadrupole magnetic lenses were resolved in series. This makes it possible by solution of quadratic equations to attain approximate values of the field gradients in lenses, guaranteeing the desired transformation of the bundle (for a stigmatic source and image). (tr-auth).

23381 WIDEBAND CABLE FOR POWER TRANSMISSION FROM THE AMPLIFIER TO THE ACCELERATING RESONATER OF A SYNCHROTRON. Ostreiko, G. N.; Panasyuk, V. S.; Panfilov, A. D.; Sedlyarov, I. K. (Inst. of Nuclear Physics, Novosibirsk, USSR). Prib. Tekh. Eksp., No. 1, 38-41(Jan.-Feb. 1967). (In Russian).

A wideband cable for high frequency power transmission from an amplifier to the symmetrical accelerating resonater of a synchrotron was described. The frequency characteristics of the cable and its transformation during the change of some parameters were reported. The effects of supplementary resonance in the system of symmetrical feed of the resonator on the coaxial feeder was examined. (tr-auth)

23382 CALCULATION OF PARTICLE TRANSPORTATION CHANNELS. Bondarev, B. I. (Radiotechnical Inst., Moscow). Prib. Tekh. Eksp., No. 1, 41-3(Jan.-Feb. 1967). (In Russian).

Stability diagrams are presented which make possible the calculation of transmission channels with periodically inclined lenses, m-quadrupole doublets, and lenses with longitudinal magnetic fields. (tr-auth)

23383 INVESTIGATION OF THE OPERATION OF THE DUOPLASMATRON DURING PULSE INJECTION OF THE GAS. Mal'tsev, V. V.; Otroshchenko, G. A.; Sidorov, N. I. (Inst. of Atomic Energy, Moscow). Prib. Tekh. Eksp., No. 1, 140-2 (Jan.-Feb. 1967). (In Russian).

The composition of the pulsed ion beam of the duoplasmatron during continuous and pulsed injection of the gas was measured. With an increase in the period of the pulse sequence the concentration of the proton components decreased. In operation with tritium an ion current T^+ of 3 mA is obtained in the pulse duration of 2 msec with a repetition of 30 sec. The tritium output per pulse is 10^{-3} cm^3, converted to normal conditions. (tr-auth)

23384 ANGULAR DISTRIBUTION OF THE SYNCHROTRON RADIATION INTENSITY. Rzaev, R. A. Izv. Akad. Nauk Azerbaidzh. SSR, Ser. Fiz.-Tekh. Mat. Nauk, No. 2, 55-61(1965). (In Russian).

The angular distribution of the total and polarized components of synchrotron radiation is investigated at electron energies from 300 to 1000 MeV. The angular distribution of the W_2- or sigma polarized component does not depend on the electron energy in the region of the maximum of the spectral intensity. The half-width of the curve decreases somewhat slower than according to $A\,(1-\beta^2)^{0.5}$ rule. The maximum of the W_2 polarized component lies in the plane of the electron rotational orbit ($\theta = \pi/2$). The W_3-component (the π-component of polarization) is symmetrically shifted a distance from $\theta = \pi/2$, and it is possible to obtain two maxima in the angular distribution of intensities. Expressions are obtained for the radiation intensity in the quatum jump region from electrons with an oriented spin. It is shown that if the spin is directed against the field, the radiation intensity increases for a transverse polarized electron. With longitudinally polarized electrons, an asymmetry is noted in the intensity distribution. (TTT)

23385 GAMMA DOSE RATES AROUND A VAN DE GRAAFF ACCELERATOR. Abdullah, S. A.; Hossain, A.; Hussain, M.; Siddiqi, A. A. (Atomic Energy Centre, Dacca, Pakistan). Health Phys., 13: 519-21(May 1967).

Tests of gamma radiation levels were made for a 3 MeV generator for positive ions, housed in a heavily shielded room, with 5 ft. thick walls of dense concrete, at the Atomic Energy Center, Dacca. The distribution of gamma radiation around the machine was expected to have a complex character. Isodose curves are reproduced. (UKAE)

23386 1250 kW THYRISTOR CONVERTER PLANT FOR THE CERN SYNCHROCYCLOTRON MAGNET. Schmitt, W. (Siemens Aktiengesellschaft, Erlangen, Ger.). Kerntechnik, 9: 69-71(Feb. 1967). (In German).

A 1250 kW thyristor convertor plant was supplied as the power source for the CERN-MeV synchrocyclotron in Geneva. The 12-pulse plant consists of a series connection of a controlled rectifier section and an uncontrolled rectifier section and is equipped with current control. The maximum control deviation is 2×10^{-4}. To protect the cyclotron magnets against overvoltages, an electronic-mechanical short-circuiter was incorporated which operates approximately 2 μs after the occurrence of overvoltage. The convertor plant is of modern, space-saving design. (auth)

23387 LINOTRON: A SHORT LINEAR ACCELERATOR. Kolomenskii, A. A. JETP Lett. (USSR)(Engl. Transl.), 5: 164-6(Mar. 15, 1967).

Translated from Zh. Eksp. Teor. Fiz., Pis'ma Redaktsiyu, 5: 204-7(Mar. 15, 1967).

The possibility of producing accelerating systems in which a given linear accelerator can yield energy several times larger than that for which it is nominally designed is pointed out. The possible realization of such systems, which are called linotrons, is based on the peculiarities of the particle dynamics in a linear accelerator constituting an iris-loaded waveguide. The theory for the operation of a linotron is given. (J.F.P.)

23388 FIXED-FIELD, ALTERNATING-GRADIENT PARTICLE ACCELERATORS. Ianovici, M. (Inst. of Atomic Physics, Bucharest). Stud. Cercet. Fiz., 18: 919-46(1966). (In Rumanian).

The first concept of a fixed-field, alternating-gradient (FFAG)-type accelerator was presented in 1938 by Thomas; actual experiments were carried out in 1950 at Berkeley but because of classification, the results were not published until 1956. Soon, independent tests were carried out at several locations and by 1956, the field became sufficiently important for an international symposium at CERN. Today, there are a number of isochronous FFAG cyclotrons in operation. The magnetic field of these machines is time-constant as in the case of other cyclotrons but it increases from the center toward the periphery, making it possible to synchronize the rotational frequency of the accelerated particles with the accelerating tension; this is done in principle without limitation of the energy, although the energy is limited for other reasons. Construction of these machines raises difficult design problems; therefore, their cost is higher than that of conventional machines of the same energy. They present several important advantages, such as higher intensity at elevated energies and ability to accelerate crossed beams. The demands of physicists for ever-higher energies will probably tip the balance in the favor of strong-focusing proton synchrotrons. Further improvements of the FFAG-type may be expected. (Review article, 11 references). (TTT)

23389 ELECTRON CAPTURE DURING THE BETATRON ACCELERATION PROCESS. Scarlat, F. (Inst. of Atomic

Physics, Bucharest). Stud. Cercet. Fiz., 18: 947-67(1966). (In Rumanian).

The radiation intensity of betatrons and cyclotrons is not as high as expected because the electron capture mechanism during the acceleration process is only incompletely understood. No generally valid macroscopic or microscopic theory has been developed yet. It was shown experimentally that capture takes place during all of the three phases of the injection; if low currents are used, the capture is more efficient during the first portion; with high currents, during the second level and the final portions; the capture mechanisms involved are different. Most of the proposed models refer primarily to the behavior of a single electron and to a much lesser extent to that of the beam as a whole. It appears desirable to determine first the beam structure, developing afterwards a model to simulate the actual situation. The chief difficulty lies in the fact that up to now, no parametric identity of the azimuthal field distribution of the various betatrons was established. An electron-capture mechanism should be helpful to calculate the physical and geometric elements of a betatron or synchrotron, in order to obtain a given radiation intensity or a given number of extracted electrons, thus eliminating the current need for empirical tests. (TTT)

23390 SOURCE OF NEGATIVELY CHARGED PARTICLES. Consoli, Terenzio; Geller, Richard (to Commissariat a l'Energie Atomique). British Patent 1,063,279. Mar. 30, 1967. Priority date Oct. 14, 1964, France.

An electron source is described in which a high energy electron beam is produced. The electron source consists of a means for generating a jet of a high energy plasma; a means for generating a magnetic field, the intensity of which decreases in the direction of jet flow; two electrically conductive parallel plates at right angles to the longitudinal axis of the jet; and an aperture in the plates by which the electrons are transmitted while the positive charges are collected on the negative plate. (B.G.D.)

23391 SOURCE OF POSITIVELY CHARGED PARTICLES. Consoli, Terenzio; Geller, Richard (to Commissariat a l'Energie Atomique). British Patent 1,063,199. Mar. 30, 1967. Priority date Oct. 14, 1964, France.

An ion source is described in which a high energy positive ion beam is produced. The ion source consists of a means for generating a jet of high energy plasma; a means for generating a magnetic field, the intensity of which decreases in the direction of jet flow; two electrically conductive parallel plates at right angles to the longitudinal axis of the jet; and an aperture in the plates by which the positive charges are transmitted while the negative charges are collected on the positive plate. (B.G.D.)

PHYSICS (NUCLEAR)

Neutron Interactions with Matter

Refer also to abstracts 23241, 23242, 23272, 23274, and 23741.

23392 (ANL–7131) STOCHASTIC PROBLEMS IN TRANSPORT THEORY. Brockwell, Peter John (Argonne National Lab., Ill.). Aug. 1966. Contract W-31-109-eng-38. 142p. Dep. mn. CFSTI $3.00 cy, $0.65 mn.

The application of the theory of discontinuous Markov processes and stochastic population processes to problems in the field of transport theory is investigated. It is shown how a scattering process (in which there may, at each collision, be a constant probability that the scattered particle is absorbed and lost to the system) can be characterized by transition probabilities $P_k(S; \Theta_1, \ldots, \Theta_k | \underset{\sim}{\omega}; s)$ of a transition $\underset{\sim}{\omega} \rightarrow S$ in distance s with exactly k scatterings, the angles of scattering $\theta_1, \ldots, \theta_k$ (in order of occurrence) being such that $\theta_1 \in \Theta_1, \ldots, \theta_k \in \Theta_k$. Such a characterization is of importance when there is a change of state of the particle at each collision and the corresponding transition probabilities depend on the angle of deflection. For one-dimensional processes the problems simplify considerably owing to the fact that the angular deflections θ_i can take only two values, 0 or π. A detailed investigation of one-dimensional problems in which the probability of a collision in a small element of path length δs is $\lambda \delta s + o(\delta s)$ is made. In order to apply the theory to scattering in three dimensions, an approximation is made in which scattered particles are assumed to move in one of a set of 30 directions in space. This model is considered in detail. A particular one-dimensional problem which arises in the analysis of bubble chamber tracks and is concerned with the stochastic population process generated by the distances traveled between successive collisions in a fixed length of track is considered. One-dimensional processes in which the distances traveled by a particle between successive collisions have either a gamma distribution or a distribution which is a linear combination of negative exponential distributions are discussed. Processes of the latter kind can be used to improve the approximation (used by Fermi and others) to the projection on a fixed axis of the three-dimensional motion of a particle which is scattered isotropically. Multiplicative scattering processes in one dimension are also considered. Several mathematical models for one-dimensional neutron multiplication in a rod are considered, with particular reference to the concept of criticality and the distribution of the number of emergent neutrons produced by a single trigger neutron. (auth)

23393 (GA–7480) INTEGRAL NEUTRON THERMALIZATION. Annual Summary Report, October 1, 1965–September 30, 1966. Beyster, J. R.; Antunez, H.; Borgonovi, G.; (and others) (General Dynamics Corp., San Diego, Calif. General Atomic Div.). Nov. 30, 1966. Contract AT(04-3)-167. 548p. Dep. mn. CFSTI $3.00 cy, $0.65 mn.

The code GASKET was successfully used to generate the inelastic incoherent scattering laws for a variety of common reactor moderators. Neutron thermalization in H_2O was studied extensively, although no new model was formulated. Studies of the multiple scattering corrections to double differential measurements on H_2O were made. The corrections are important and model dependent, however, it is not possible to use them to obtain consistent results in every case. Multiple scattering corrections to angular scattering measurements were made; supporting experimental studies were also performed. For D_2O, a scattering law based on a measured frequency spectrum of Haywood was generated by GASKET. It was tested and sent to ENDF. For polyethylene, only angular scattering measurements have been performed this year. It is clear from these measurements, and comparisons made by Koppel that several discrepancies remain between experiment and theory for that moderator. More extensive studies were made for benzene; this moderator is of interest because it is the simplest polyphenyl and the organics in organic-cooled reactors are mixtures of polyphenyls. An interim scattering law for benzene will be generated with the frequency spectrum used previously. A new study of the molecular dynamics of benzene was made which will hopefully provide an improved frequency spectrum. Scattering kernels will be obtained which can be used to calculate theoretical spectra for comparison to spectrum measurements in molten diphenyl and at a diphenyl-D_2O interface. Koppel has compared the predictions of the scattering model for zirconium hydride with various experiments and has shown that significant discrepancies remained. Consequently a central force model for ZrH_2 was formulated, and a new frequency spectrum was generated. This will be tested against experimental data which include studies performed at General Atomic. These comprise total cross section measurements and angular scattering studies as a function of temperature. A formalism was written for the computation of lattice dynamics from first principles. The methods were applied to beryllium, and surprisingly good results were obtained considering that no arbitrary parameters were used. The results are not accurate enough yet to be practical, but if the approach can be developed to give adequate precision, it will provide a powerful method for the computation of scattering cross sections for each moderator. Spectral measurements in beryllium at elevated temperatures were performed and appear to indicate that Young's present model for Be is adequate at these temperatures. A frequency spectrum for beryllium oxide was calculated. It was used to calculate a scattering law which has yet to be tested thoroughly against total cross section, angular scattering, and spectrum measurements. The spectral comparisons will include data taken last year in BeO as a function of temperature. Various spectrum measurements in uranium were performed, planned, or analyzed. Fast leakage spectrum measurements from a ^{235}U metal ball reactor were made a year ago. The data were analyzed and show more epithermal neutrons than the theory predicts. The studies are sufficiently encouraging to justify making internal spectrum measurements. Spectrum measurements in depleted uranium were performed in the resonance energy range as a function of position across a thick slab surrounded by polyethylene. The data were reduced but were not analyzed. They are expected to shed light on some of the approximations currently used in calculating resonance escape probability. Finally, approximate scattering kernels for UO_2 and UC are being computed since thermalization in the bound light atom has been found to be important under certain conditions. (auth)

23394 (EUR–3262.e) SOME NUMERICAL SCHEMES FOR NEUTRON DIFFUSION PROBLEMS. Roos, J. P. (European Atomic Energy Community, Ispra (Italy). Joint Nuclear Research Center. European Atomic Energy Community, Ispra (Italy). European Scientific Data Processing Center). Nov. 21, 1966. 52p. Dep. mn.

Three finite-difference schemes for the numerical solution of general elliptic partial differential equations are compared with respect to accuracy and convergence. Five-point, nine-point, and mixed-type finite-difference formulas are derived using a variational principle established for these elliptic equations. (D.C.W.)

23395 (EUR–3275.e) THE CONNECTION BETWEEN THE TIME-MOMENTS AND THE FUNDAMENTAL DECAY CONSTANT OF A THERMALIZED NEUTRON PULSE. Hembd, H. (European Atomic Energy Community, Ispra (Italy). Joint Nuclear Research Center). 1967. 16p. Dep. mn.

The decay of a thermalized neutron pulse in a large moderating sample is studied by the time moments method applied to the Boltzmann equation. The time moments define the mean emission time for lifetime for neutrons before escaping or being absorbed at a certain energy. The decay constant of the neutron pulse is derived as a mean value of the inverse emission time. The first three coefficients in the expansion of the decay constant in terms of the geometrical buckling are identical with those obtained by Nelkin in his eigenvalue approach. Further properties of the time moments and their connection with the experiment are pointed out. (auth)

23396 (GA–6583) DIFFERENTIAL NEUTRON THERMALIZATION. Annual Summary Report, October 1, 1964–September 30, 1965. Whittemore, W. L. (General Dynamics Corp., San Diego, Calif. General Atomic Div.). Dec. 2, 1965. Contract AT(04-3)-167. 81p. Dep. mn. CFSTI $3.00 cy, $0.65 mn.

The General Atomic Neutron Velocity Selector was used for the study of inelastic scattering of monoenergetic neutrons in a variety of materials. The scattering into various angular directions between 30° and 150° was studied for incident neutrons with energies up to 0.6 eV. Because of the ability of this apparatus to study details of single scattering events with neutrons which have energies significantly higher than are available with reactor-based experiments, most of the present work was done for $E_0 > 0.20$ eV. The exact incident energy was chosen to optimize the ability to study various chemical rotation and vibration levels in this higher energy region. Technical details of the experimental apparatus are discussed. Numerous details are given for neutron interactions in polyethylene, methane, graphite, and hydrides of rare earth metals. In most cases, theoretical results are compared in detail with experimental results. (auth)

23397 (IA–1063) NEW INTERPRETATION OF THE QUASI-ELASTIC SCATTERING OF SLOW NEUTRONS IN WATER.

Pelah, I.; Imry, Y. (Israel Atomic Energy Commission, Yavne. Soreq Nuclear Research Center). Nov. 1966. 16p. Dep. mn.

The quasielastic scattering of slow neutrons in water is described according to the following model. At room temperature, water consists of aggregates of a few hundred H_2O molecules each. The aggregates are weakly interacting and form a structure with a characteristic temperature of about 3°K. The scattered neutron spectrum from this system at low energy transfers consists of a superposition of multi-phonon processes. This gives an effect roughly similar to a broadening of the elastic line, although a fine structure caused by individual n-phonon processes exists, as observed by high resolution experiments. Experiments with low resolutions or higher momentum transfer ($\gtrsim 4$ Å^{-1}) will not detect the details of the spectrum and only a "heavy-gas" picture will be revealed. The internal motions of molecules in the aggregates determine the inelastic part of the neutron spectrum. With increasing temperature the aggregate size drops and the broadening increases. The possible advantages of this picture over the existing diffusion models are indicated. (auth)

23398 (NP-16622) GAIN EN NEUTRONS OBTENU DANS UN MODERATEUR ANISOTROPE (COMPTE-RENDU DE MANIPULATION). (Neutron Gain Obtained in an Anisotropic Moderator (Manipulation of Counter Return)). Note Technique Acc. 65-03. Mouraille, H. (Commissariat a l'Energie Atomique, Grenoble (France). Centre d'Etudes Nucleaires). Jan. 1965. 18p. (In French). Dep. mn.

The effect of an anisotropic moderator on the behavior of a current of thermal and epicadmium neutrons was studied. The experimental setup is described. The results showed that the gain obtained by means of an anisotropic geometry has two origins: the anisotropy effect and the drilling of holes which causes an increase of the leak surface in the vicinity of the channel input. In a preceding series of measurements, a gain was recorded always with respect to a homogeneous and isotropic geometry by making the central cavity free of all moderator. Nevertheless, the gain in fast neutrons was considerably higher. (tr-auth)

23399 RIGOROUS SOLUTIONS OF MILNE'S PROBLEM FOR TWO ADJACENT HALF-SPACES. Korn, Axel (Technische Hochschule, Karlsruhe, Ger.). Nukleonik, 9: 237-41(Mar. 1967).

The solution of the monoenergetic, time-dependent Boltzmann equation in the P_1 approximation and for linear anisotropic scattering is recalled. This solution must fulfill the condition that the neutron distribution has to be continuous across the boundary between two different media. This requirement yields a system of L + 1 algebraic equations for the determination of the unknown coefficients in both solutions since only the case of two infinitely extended media is considered. The order L of the approximation only appears in a function $h_L(\lambda)$. The limit of this function when L approaches ∞ is known, and rigorous solutions of the transport equation in plane geometry are obtained for this problem which is very suitable for numerical calculations. Some tables of numerical results for isotropic scattering are given. (auth)

23400 ITERATIVE SOLUTION OF THE COUPLED INTEGRAL EQUATIONS IN CRITICALITY COMPUTATIONS. Gopinath, D. V.; Sundaram, V. K.; Krishnan, L. V.; Santhanam, K. (Atomic Energy Establishment, Trombay, India). Nukleonik, 9: 252-6(Mar. 1967).

A method of obtaining critical parameters through iterative solution of the coupled integral equations $C(E,r) = \int_V S(E,r') K(E,r' \rightarrow r)dr'$ and $S(E,r) = \int_{E'} C(E',r)G(r,E' \rightarrow E)dE'$ where S(E,r) and C(E,r) are source and collision densities, respectively, of neutrons of energy E at r and K and G are the space and energy transfer matrices. For one-region spherical systems, K is obtained analytically; for two-region spherical systems it is obtained partly analytically and partly numerically through evaluation of a single-fold integral. The integral equations are then solved using finite difference approximations. Critical dimensions for Pu systems calculated using this method are presented and are compared with those obtained by the S_n method. There is good agreement with S_{16} values. A significant reduction in computing time is also observed. The effect of convergence criteria and spatial mesh size are discussed. (auth)

23401 CALCULATION OF THE SPATIAL AND ANGULAR DISTRIBUTION OF NEUTRONS IN PLANE, MULTILAYER SYSTEMS. Slesarev, I. S.; Khromov, V. V. pp 53-66 of Inzhenerno-Fizicheskie Voprosy Yadernykh Reaktorov. Yurovoi, L. N. (ed.). Moscow, Atomizdat, 1966. (In Russian).

Multidimensional, multigroup and nonstationary problems have been successfully solved by computer-based calculations involving models. Such a method was developed for the solution of multidimensional problems, making use of an arbitrary division of spatial variables of the transport equation. The method is especially well suited for calculating systems consisting of a large number of thin layers with varying properties; most of the errors encountered in the diffusion method were eliminated. The field of a plane-parallel reactor was used as an example of the method, together with a plane, multiregion reactor. The perturbation theory was applied for determining the error inherent in the method and a special iteration scheme was developed for determining the eigenvalue of the system. (TTT)

Nuclear Properties and Reactions, A≤ 5

Refer also to abstracts 22771 and 23534.

23402 (BNL-11285) NUCLEAR STRUCTURE RESULTS DERIVED FROM INTERACTIONS OF PROTONS IN THE GeV REGION. Palevsky, Harry (Brookhaven National Lab., Upton, N. Y.). [1967]. Contract AT(30-2)-Gen-16. 34p. (CONF-670207-3). Dep. mn. CFSTI $3.00 cy, $0.65 mn.

From 2nd International Conference on High Energy Physics and Nuclear Structure, Rehovoth, Israel.

Protons are used as a nuclear probe in experiments to determine nuclear structure. In these experiments an attempt is made to satisfy the conditions that the wavelength of the probe must be comparable to or smaller than the characteristic spacing of the nucleons, and that the energy resolution of the measuring system must be smaller than or comparable to the spacings of the energy levels of the nucleus under investigation. The hydrogen and the proton-helium-4 cross sections are discussed. (J.F.P.)

23403 (LA-DC-8639) LOW ENERGY NEUTRON-PROTON POLARIZATION EXPERIMENTS. Simmons, J. E. (Los Alamos Scientific Lab., N. Mex.). [1966]. Contract W-7405-eng-36. 16p. (CONF-670302-4). Dep. mn. CFSTI $3.00 cy, $0.65 mn.

From American Physical Society, Nucleon-Nucleon Interaction Conference, Gainesville, Fla.

The status of n-p scattering and polarization experiments near 25 MeV is reviewed. Recent data on polarization and spin correlation observables are discussed in relation to phase-shift analyses, with some emphasis on the role of the s-d coupling parameter. (auth)

23404 (ORNL-P-2914) NEUTRON CROSS SECTIONS AND REACTION PRODUCTS FOR H, C, N, AND O FOR THE ENERGY RANGE FROM THERMAL TO 15 MeV. Auxier, J. A.; Brown, M. D. (Oak Ridge National Lab., Tenn.). [1966]. Contract W-7405-eng-26. 16p. (CONF-660920-15). Dep. mn. CFSTI $3.00 cy, $0.65 mn.

From 1st International Congress of the International Radiation Protection Assn., Rome, Italy.

The accurate calculation of neutron dose must be based on definitive cross sections and a precise knowledge of the reaction products in tissue. Although there are still several uncertainties in these parameters, a compilation has been made of the most detailed cross-section data available and reaction products for the four major elements in tissue (i.e., H, C, N, and O). The compilation is for neutron energies below 15 MeV, but the energy interval requiring the most study and analysis was that from 2.5 to 15 MeV. Particular attention was directed to the nonelastic reactions [e.g., the C(n,n') 3α reaction]. Average values for the energies of the various charged particles as a function of the energy of the incident neutron have been computed. These values were compiled to provide a basis for revision of the dose-distribution functions for neutron exposures of man and of animals used in radiobiological studies. An analysis of the results of various measurements are compared with calculated values based on these cross sections and with the values listed in NBS Handbook 63. (auth)

23405 (UCRL-70376) CONCEPT FOR AN ENERGY DEPENDENT NEUTRON-NEUTRON SCATTERING EXPERIMENT USING A NUCLEAR EXPLOSION. Dickinson, W. C.; Bowman, C. D. (California Univ., Livermore. Lawrence Radiation Lab.). Mar. 17, 1967. Contract W-7405-eng-48. 11p. (CONF-670302-3). Dep. mn. CFSTI $3.00 cy, $0.65 mn.

From American Physical Society, Nucleon-Nucleon Interaction Conference, Gainesville, Fla.

An experiment that could be used to determine the n-n scattering length using a nuclear explosion as the neutron source is proposed. The experimental geometry is discussed in detail. (D.C.W.)

23406 BETA-DECAY OF THE HYPERTRITON. Chen, C. T.; Lee, T. Y.; Tyan, Y. L. (Tsing Hua Univ., Hsinchu, Taiwan). Nuovo Cim. (10), 47A: 735-41(Feb. 21, 1967).

The β decay of the hypertition is considered. The partial and total decay rates are calculated and are expressed graphically as functions of the V-A coupling constant ratio C_V/C_A as well at the spin states of the hypertriton. (auth)

23407 THE $^2H(p,\gamma)^3He$ REACTION AT THE BREAKUP THRESHOLD. Geller, K. N. (Univ. of Pennsylvania, Philadelphia); Muirhead, E. G.; Cohen, L. D. Nucl. Phys., A96: 397-400(1967).

Gamma-ray yields with $^2H(p,\gamma)^3He$ reaction were measured in the region of the deuteron breakup threshold. The excitation function does not display any cross-section anomaly of significance at the breakup threshold. (auth)

23408 A MEASUREMENT OF THE p-^{4}He DIFFERENTIAL ELASTIC SCATTERING CROSS SECTION AT 49 MeV AND PHASE SHIFT ANALYSES OF p-^{4}He SCATTERING. Davies, B. W. (London Univ.); Craddock, M. K.; Hanna, R. C.; Moroz, Z. J.; Robertson, L. P. Nucl. Phys., A97: 241-62(1967).

A measurement of the differential elastic cross section for 48.8-MeV protons scattered from helium is reported. The measurement was made at 29 angles between 18.9 and 163.7° (cms). Phase shift analyses were made of reported experimental data at 29, 40, and 48 MeV; and error matrices for these solutions are given. The best solution of the 40-MeV phase-shift analysis appears to lie between those reported by Giamati and Thaler and by Suwa and Yokosawa. (auth)

23409 NUCLEAR CORRELATIONS AND INELASTIC ELECTRON SCATTERING ON ^{3}He. Khanna, Faqir C. (Atomic Energy of Canada, Ltd., Chalk River, Ont.). Nucl. Phys., A97: 417-24 (1967).

The effect of short-range correlations on the cross section for the inelastic scattering of electrons on ^{3}He is investigated. Reasonable forms for the correlations show a 20% increase in the cross section near the maximum at ≈53° proton angle, over the value when no such correlations are included. The parameters in the ground state wave function are fixed by fitting the charge form factor of ^{3}He. With an exponential radial dependence of the correlations, a reasonable fit to the absolute cross section can be achieved. (auth)

23410 EFFECTS OF NUCLEAR AND COULOMB INTERACTION OF NUCLEONS IN THE FINAL STATE IN THE CASE OF THREE-PARTICLE PHOTODISINTEGRATION OF THE ^{3}He NUCLEUS. Fetisov, V. I.; Gorbunov, A. N.; Varfolomeev, A. T. (Lebedev Inst. of Physics, Moscow). JETP Lett. (USSR) (Engl. Transl.), 5: 150-2(Mar. 15, 1967).

Translated from Zh. Eksp. Teor. Fiz., Pis'ma Redaktsiyu, 5: 189-92(Mar. 15, 1967).

The role of Coulomb effects in the reaction $\gamma + {}^3He \rightarrow 2p + n$ was studied. The energy spectra of the neutrons and protons were calculated assuming a single-particle nuclear excitation mechanism and adding a Coulomb field to the nuclear potential of the (p,p) interaction in the channel $\gamma + {}^3He \rightarrow (p + p)_{l=0} + n$. The results show that the nuclear forces are not balanced by the Coulomb field and that the distorted-wave theory satisfactorily describes the spectra. (D.C.W.)

Nuclear Properties and Reactions, 6≤A≤19

Refer also to abstracts 23238, 23404, 23479, 23534, 23535, 23545, 23556, and 23582.

23411 (AD-643811) T = 3/2 LEVELS IN ^{17}F. Adelberger, E. G.; Barnes, C. A. (California Inst. of Tech., Pasadena). Oct. 1966. Contract Nonr-220(47). 8p. CFSTI $3.00 cy, $0.65 mn.

T = 3/2 levels in fluorine-17 were seen at excitation energies of 11.195, 12.544, and 13.055 MeV in the reaction ^{15}N (^{3}He,n). Angular distributions lead to spin assignments of $\frac{1}{2}^-$ for the 11.195-MeV level, and $\frac{3}{2}^-$ or $\frac{5}{2}^-$ for the level at 12.544 MeV. (auth)

23412 (JINR-P04-3178) UROVNI POLOZHITEL'NOI CHETNOSTI V ^{15}N. (Positive Parity Levels in ^{15}N). Zhusupov, M. A.; Karepetyan, V. V.; Eramzhyan, R. A. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Theoretical Physics). 1967. 19p. (In Russian). Dep. mn.

The spectrum of positive-parity levels in A = 15 is calculated in the framework of the shell model with intermediate coupling. The log-ft values for the allowed β transitions $C^{15} \rightarrow N^{15}$ and the widths of electromagnetic transitions between the bound states of N^{15} are calculated. (auth)

23413 (UCRL-50197) APPLICATION OF CHARGE INDEPENDENCE TO NEUTRON INELASTIC SCATTERING. Anderson, John D.; Wong, Calvin; Madsen, Victor A. (California Univ., Livermore. Lawrence Radiation Lab.). Feb. 27, 1967. Contract W-7405-eng-48. 11p. Dep. mn. CFSTI $3.00 cy, $0.65 mn.

For several light nuclei such as ^{6}Li, ^{10}B and ^{14}N there exists a simple relation between (n,n'), (n,p), (p,n), and (p,p') cross sections for analog reactions. The derivation of this relation is briefly discussed, and the basic assumptions are noted. As a practical example, ^{14}N is considered and (n,n') cross sections are obtained from the application of these relations. (auth)

23414 ATTENUATION CROSS-SECTIONS FOR 650 MeV DEUTERONS. Jafar, J. D.; MacMahon, T. J.; van der Raay, H. B.; Reading, D. H.; Ruddick, K.; Ryan, D. G. (Univ. of Birmingham, Eng.). Nuovo Cimento (10), 48A: 165-71(Mar. 1, 1967).

The attenuation cross sections for 650-MeV deuterons incident on C, Al, Cu, Cd, and Pb were measured for various geometries. An analysis yields the elastic and absorption cross sections. It is shown that the absorption cross sections measured in this way refer to protons of half the incident deuteron energy. The absorption cross sections show a clear $A^{\frac{2}{3}}$ dependence and an optical-model analysis yields a mean value of $r_0 = 1.190 \pm 0.005$ fm. (auth)

23415 MIGDAL'S THEORY OF NUCLEAR STRUCTURE AND PARTIAL MUON CAPTURE RATES IN ^{16}O. Rho, Mannque (Univ. of Virginia, Charlottesville). Phys. Rev. Lett., 18: 671-5(Apr. 17, 1967). (ORO-2915-72).

The partial muon-capture rates in O^{16} leading to low-lying states in N^{16} are calculated in Migdal's theory of nuclear structure, with results that agree well with the available experiments for suitable values of $C_p = m_\mu F_p / F_A$. It is thus argued that the neglect of G-parity irregular terms was not the cause of previous apparent disagreement. The capture rates are in turn employed to examine the effect of the velocity-dependent terms in Migdal's effective amplitude. (auth)

23416 ANALYSIS OF ^{6}Li(p,p) ELASTIC SCATTERING. Lejeune, A. (Univ., Liege). Bull. Soc. Roy. Sci. Liege, 35: 566-74(1966). (In French).

The experimental differential cross sections for elastic scattering of protons from ^{6}Li were analyzed over the laboratory energy range from 0.49 to 2.86 MeV. Using the S-matrix theory of nuclear reactions with two different penetration factors, the $\frac{1}{2}^-$ resonance was located at $E_R = 1.47$ MeV in the center-of-mass system and ascribed a total width of $\Gamma_R = 0.47$ MeV, appreciably smaller than the one derived earlier from an R-matrix analysis. (auth)

23417 LOW-Q $^{14}C(d,p)^{15}C$ STRIPPING REACTIONS. Nelson, John B. (Univ. of Texas, Austin); Smith, William R. Contract AT(40-1)-1049. Nucl. Phys., A96: 671-88(1967).

Angular distributions were obtained for $^{14}C(d,d)^{14}C$ elastic scattering at an energy of 3.4 MeV and for the $^{14}C(d,p)^{15}C$ reactions leading to the ground and first excited states of ^{15}C with Q-values of −1.007 and −1.752 MeV, respectively, at bombarding energies of 2.0, 2.6, 3.0 and 3.4 MeV in the former case and energies of 3.0 and 3.4 MeV in the latter case. Optical-model parameters determined from the elastic scattering yielded good agreement with the stripping when employed in DWBA calculations. PWBA and Coulomb wave Born approximation calculations could also be made to resemble the data if the lower radial integration cut-off were suitably adjusted, but it was concluded that such fits were probably due to the simple shapes of the experimental angular distributions combined with the large range of calculated shapes obtainable by varying the cut-off radius. (auth)

23418 CROSS SECTIONS OF THE NUCLEAR REACTIONS $^6Li(p,\alpha)^3He$ AND $^7Li(p,\alpha)^4He$ AT LOW ENERGIES. Fiedler, O.; Kunze, P. (Technische Univ., Dresden). Nucl. Phys., A96: 513-20(1967). (In German).

The cross sections of the reactions $^6Li(p,\alpha)^3He$ and $^7Li(p,\alpha)^4He$, measured at energies between 23 keV and 50 keV, range from 100 to 0.01 μb. The constant ratio $\sigma_{^6Li}/\sigma_{^7Li}$ confirms that the energy dependence of the transparency of the potential wall is approximately the same for s-wave and p-wave protons at these low energies. The relation $\sigma \propto (1/E) \exp(-B/\sqrt{E})$ applies to both reactions with $B = 90 \pm 6$ keV$^{\frac{1}{2}}$ and 91.5 ± 4.5 keV$^{\frac{1}{2}}$, respectively. (auth)

23419 LEVELS IN ^{18}O THROUGH THE RADIATIVE CAPTURE OF ALPHA PARTICLES BY ^{14}C. Lee, F. D.; Krone, R. W.; Prosser, F. W. Jr. (Univ. of Kansas, Lawrence). Nucl. Phys., A96: 209-28(1967). (COO-1120-48).

The reaction $^{14}C(\alpha,\gamma)^{18}O$ was studied for α-particle energies between $E_\alpha = 0.50$ and 3.00 MeV. Three previously reported resonances were observed, as well as a new resonance at $E_\alpha = 2440$ keV. Coincidence studies were made to determine the γ-ray decay schemes at each resonance. The spins and parities of eight excited states of energy greater than 3.92 MeV in ^{18}O were assigned or confirmed from double and triple angular correlation measurement. Also determined were multipole mixing ratios for resonance γ rays. Of interest are the $J^\pi = 1^-$ and 5^- assignment for the 4.45- and 8.13-Mev states, respectively. An unsuccessful attempt was made to fit the $J^\pi = 5^-$ state into a predicted band of negative-

parity states, the initial member of which was assumed to be the 4.45-MeV 1^- state. (auth)

23420 THE $^9Be(n,\alpha_0)^6He$ REACTION INDUCED BY 14.4-MeV NEUTRONS. Paic, G.; Rendic, D.; Tomas, P. (Rudjer Boskovic Inst., Zagreb). Nucl. Phys., A96: 476-80(1967).

The differential cross section of the $^9Be(n,\alpha_0)^6He$ reaction was measured using a counter telescope discriminating ^4He and ^6He particles. The angular distribution is compared with heavy particle stripping theory. The total cross section is $\sigma = 11.7 \pm 1.8$ mb. (auth)

23421 ANGULAR CORRELATION MEASUREMENTS OF ^{12}C $^{12}C(n,n'\gamma)^{12}C$ AT 14.7 MeV. Zamudio, J.; Romero, L.; Morales, R. (Univ., Chile, Santiago). Nucl. Phys., A96: 449-62(1967).

Gamma rays from the $2^+ - 0^+$ de-excitation of the first excited state in ^{12}C were observed in coincidence with inelastically scattered neutrons. Neutrons of 14.7 MeV were generated by means of the $^3H(d,n)^4He$ reaction. Background was minimized by requiring coincidence between the neutrons and the associated α particles. The time-of-flight technique was necessary to distinguish neutron-gamma from gamma-neutron events. Measurements were performed in the reaction plane for five different neutron detector positions and in a plane perpendicular to the reaction plane for two neutron detector positions. The correlation patterns are similar to those produced in proton inelastic scattering and can be explained in terms of direct interaction mechanisms. (auth)

23422 ELASTIC AND INELASTIC SCATTERING OF 50-MeV PROTONS BY ^{12}C AND ^{16}O. Fannon, J. A. (London Univ.); Burge, E. J.; Smith, D. A.; Ganguly, N. K. Nucl. Phys., A97: 263-81(1967).

Measurements are reported of the differential cross sections for the elastic scattering of 49.48-MeV protons by ^{12}C and ^{16}O and the inelastic scattering leading to the 4.43- and 7.67-MeV levels of ^{12}C. The results for ^{12}C, together with values for polarization, are fitted by the optical model; and the parameters compared with revised fits of the 30.3- and 40-MeV data. The radius and the diffuseness of the spin-orbit potential are found to be smaller than the values for the central potential. The ^{12}C elastic and 4.43-MeV inelastic data are fitted with a strong-coupling model. Preliminary optical-model parameters are given for the ^{16}O data. It is evident from the present studies that there is a need for more measurements of polarization and differential cross sections at larger angles and of the total reaction cross section, in order to provide an adequate test of the applicability of the optical model. (auth)

23423 STUDY OF THE REACTION $^{11}B + p \rightarrow 3\alpha$ AT E_p = 7.18 MeV. Marquez, L. (Faculte des Sciences, Bordeaux); Laugier, J. P.; Ballini, R.; Lemeille, C.; Saunier, N.; Rey, J. Nucl. Phys., A97: 321-36(1967). (In French).

Several continuous α-particle spectra were measured from the sequential reaction $^{11}B + p \rightarrow {}^{12}{}^*C \rightarrow \alpha + {}^8{}^*Be \rightarrow 3\alpha$ at $E_p = 7.18$ MeV. The measured spectra are in agreement with a theoretical expression derived on simple assumptions except when all the energy available is taken up by 2 α particles. This type of event is forbidden. (auth)

23424 THE $^{19}F(p,\alpha)^{16}O$, $^{12}C(p,\alpha)^9B$, AND $^7Li(p,\alpha)^4He$ REACTIONS NEAR 45 MeV. Craig, R. M.; Hird, B.; Kost, C. J.; Li, T. Y. (Univ. of Manitoba, Winnipeg). Nucl. Phys., A96: 367-76 (1967).

Ground-state group (p,α) angular distributions were obtained at energies between 30.5 and 45 MeV. It appears that an energy range free from significant resonance effects was found for the (p,α) reaction. The main process for the $^{19}F(p,\alpha)^{16}O$ and the $^{12}C(p,\alpha)^9B$ reaction is direct triton pickup; however, the backward angle region is quite different for the two angular distributions, and the $^{12}C(p,\alpha)^9B$ reaction probably contains significant heavy particle stripping. (auth)

23425 CLUSTER MODEL WAVE FUNCTION OF ^6Li. Lodhi, M. A. K. (Texas Technological Coll., Lubbock). Nucl. Phys., A97: 449-57(1967).

The wave function of ^6Li was constructed in the cluster model by considering an alpha and deuteron cluster configuration. This wave function is obtainable on proper antisymmetrization from a two-oscillator, parametric, single-particle wave function in the shell model. The separation parameter is a function of the parameter is a function of the parameters belonging to the alpha and deuteron clusters. This wave function was used to calculate the rms radius of ^6Li. (auth)

23426 THE RATIO OF K-CAPTURE TO POSITON EMISSION IN THE DECAY OF ^{11}C. Campbell, J. L.; Leiper, W.; Ledingham, K. W. D.; Drever, R. W. P. (Glasgow Univ.). Nucl. Phys., A96: 279-87(1967).

The ratio of K-electron capture to position emission in the 21-min decay of ^{11}C was measured by a flow counter technique. The counter consisted of a central proportional counter surrounded by an envelope of plastic scintillator operated in anticoincidence. The experimental value of the K/β^+ ratio was found to be 2.30×10^{-3}, in agreement with a theoretical ratio of $2.18 \pm 0.01 \times 10^{-3}$, calculated from the K-electron wave function given by Depommier et al. (auth)

23427 THREE-BODY BREAKUP IN $^7Li(d,n\alpha)^4He$ AND $^7Li(d,\alpha\alpha)n$ REACTIONS. Valkovic, V.; Jackson, W. R.; Chen, Y. S.; Emerson, S. T.; Phillips, G. C. (Rice Univ., Houston, Tex.). Contact AT(40-1)-1316. Nucl. Phys., A96: 241-57(1967). (ORO-1316-21).

The reaction $^7Li(d,n\alpha)^4He$ was studied detecting neutron-alpha coincidences. The energies of the detected particles were determined by means of time-of-flight measurement for neutrons and a silicon surface-barrier detector for alphas. Simultaneously alpha-alpha coincidences from $^7Li(d,\alpha\alpha)n$ were detected using two solid-state detectors. The measurements were performed at bombarding energies from 2.6 to 4.0 MeV in steps of 0.2 MeV. In addition the reaction $^7Li(d,\alpha\alpha)n$ was studied separately at 4.0 and 9.0 MeV for several angular settings of the two solid-state detectors. The most important reaction mechanism is found to be sequential decay through intermediate ^5He and ^8Be states. (auth)

23428 GAMMA-RAY TRANSITIONS BETWEEN THE LOW-LYING LEVELS OF ^{18}F. Warburton, E. K.; Olness, J. W.; Poletti, A. R. (Brookhaven National Lab., Upton, N. Y.). Phys. Rev., 155: 1164-70(Mar. 20, 1967). (BNL-10702).

Gamma-ray decay modes of the ^{18}F levels below an excitation energy of 4 MeV were investigated through the $^{16}O(^3He,p\gamma)^{18}F$ reaction using a 30-cc lithium-drifted germanium, Ge(Li), detector. Gamma-ray spectra were recorded at 90°, 7°, and 173° to the ^3He beam using a thick quartz target and ^3He bombarding energies of 3.45 and 6.0 MeV. Ge(Li)-NaI(Tl) coincidence spectra were also recorded at $E_{^3He} = 3.2$ MeV. Sharper upper limits than obtained previously were set on the relative intensities of many unobserved transitions. A previously unreported transition from the $J = 1$ 3.13-MeV level to the $J^\pi = 0^-$ 1.08-MeV level was observed with a branching ratio of $(27 \pm 4)\%$. The mean lifetime of the 3.13-MeV level was inferred from a Doppler-shift measurement to be $(0.37^{+0.15}_{-0.10}) \times 10^{-12}$ sec. It is conjectured that the 3.13-MeV level is the lowest $J^\pi = 1^-$ level belonging predominantly to the $p^{-1}(2s,1d)^3$ configuration. (auth)

23429 $^{14}N(^3He,t)^{14}O$ REACTION AND EXCITED ISOSPIN TRIADS IN MASS 14. Ball, Gordon C.; Cerny, Joseph (Univ. of California, Berkeley). Phys. Rev., 155: 1170-6(Mar. 20, 1967). (UCRL-17038).

The $^{14}N(^3He,t)^{14}O$ reaction was investigated at a ^3He energy of 44.6 MeV. New levels were observed in ^{14}O up to an excitation energy of 18 MeV. An investigation of the $(^3He,t)$ reaction on several other nuclei in the 1p shell, notably ^{14}C and ^{15}N, revealed that the shapes and relative magnitudes of the angular distributions arising from single-particle transitions appear to fall into groups which are characterized by the specific shell-model transition involved. Utilizing this effect and other data, it was possible to make most probable spin and parity assignments of (1−), (0+), (3−), 2+, (2−), and 2+ for the levels observed in ^{14}O at 5.17, 5.91, 6.28, 6.60, 6.79, and 7.78 MeV, respectively. A correspondence can now be established for six excited $T = 1$ levels in all three members of the mass-14 triad. (auth)

23430 DIFFERENTIAL AND TOTAL CROSS SECTIONS OF REACTION PRODUCTS FROM $^7Li + {}^6Li$ BETWEEN 3.78 AND 5.95 MeV. Kibler, K. G. (Univ. of Iowa, Iowa City). Phys. Rev., 155: 1110-18(Mar. 20, 1967).

Reactions initiated by $^7Li + {}^6Li$ have been studied at six bombarding energies between 3.78 and 5.95 MeV. A dE/dx-E system was used for particle detection and identification, and an on-line computer was utilized for pulse-height analysis, storage, and data analysis. Differential and total cross sections were obtained for protons leading to the 0.0, 0.95, 1.67, 2.62-2.72, and 3.39-MeV levels of ^{12}B; deuterons leading to the 0.0, 2.14, 4.46, 5.03, 6.76-6.81, and 7.30-MeV levels of ^{11}B; tritons leading to the 0.0 and 0.717-MeV ^{10}B levels; and alphas leading to the ^9Be ground state. The dominant reaction process appears to be the transfer of an α particle, as evidenced by the angular distributions and total cross sections for ^{10}B and ^{11}B levels. In all cases, the total cross sections are generally smoothly increasing over the observed energy range with no evidence for structure. The proton cross sections have the lowest magnitude of the particles observed here, and a compound-nucleus process seems most likely for those groups. (auth)

23431 ANGULAR-CORRELATION STUDIES OF THE REACTIONS $^{16}O(^3He,p\gamma)^{18}F$ AND $^{16}O(^3He,\alpha\gamma)^{15}O$. Gorodetzky, S.; Freeman, R. M.; Gallmann, A.; Haas, F.; Heusch, B. (Institut de Recherches Nucleaires, Strasbourg). Phys. Rev., 155: 1119-31 (Mar. 20, 1967).

The properties of some bound and nearly bound states of ^{18}F, excited in the reaction $^{16}O(^3He,p\gamma)^{18}F$, were studied by particle-gamma coincidence experiments. Angular correlations of the decay gamma rays, in coincidence with protons detected at angles close to 180° in an annular counter, were measured for three bombarding energies: 4.69, 4.84, and 5.26 MeV. Strong correlations associated with the 2.10-MeV level were observed for 5.26-MeV ^3He energy, enabling it to be shown that the 2.10 MeV → 0 transition is almost pure dipole, and to be confirmed that the 1.08-MeV level has spin zero. Results were obtained for 12 levels of ^{18}F, from 3.72- to 5.29-MeV excitation energy, which had previously been little studied. Gamma-ray decay schemes were given for all these levels, and in many cases limits were placed on their spins from the angular-correlation results. The 3.72- and 4.84-MeV levels were assigned J = 1. Further experimental support was found for the suggestion that the 4.65- 4.74-, and 4.96-MeV levels are the analog states of the 3.55-, 3.63-, and 3.92-MeV levels of ^{18}O. Among the unbound levels, no evidence was found for alpha-particle emission competing with the gamma-ray decay, except for the 5.29-MeV level, the highest level studied. Some additional results are also given for the 5.19–5.24-MeV doublet of ^{15}O excited in the reaction $^{16}O(^3He,\alpha\gamma)^{15}O$. (auth)

23432 MECHANISM OF THE $^{10}B(^3He,p)^{12*}C$ REACTION FROM THE PROTON POLARIZATIONS. Simons, Donald G. (Naval Ordnance Lab., Silver Spring, Md.). Phys. Rev., 155: 1132-4(Mar. 20, 1967).

Measurements of the polarization of protons from the $^{10}B(^3He,p)^{12*}C$(4.43 MeV) reaction were extended to the ^3He energy range from 1.75 to 2.25 MeV. The angular dependence was determined at 2.00 MeV for eight laboratory angles from 10° to 100°. In addition, measurements were made at 11 other selected angles at beam energies from 1.75 to 2.25 MeV. The results of these measurements along with previous results from measurements made at ^3He energies of 2.50 and 2.80 MeV have made it possible to study the mechanism of this reaction from the energy dependence of the proton polarizations. The smooth energy dependence observed indicates that a direct interaction mechanism is predominant for this reaction in this energy range. (auth)

23433 COUPLED-CHANNELS CALCULATION OF THE ELASTIC AND INELASTIC SCATTERING OF PROTONS BY ^{12}C. Barnard, A. C. L. (IBM Scientific Center, Houston, Tex.). Phys. Rev., 155: 1135-9(Mar. 20, 1967).

The elastic scattering of protons by ^{12}C exhibits the following resonances with an appreciable fraction of the single-particle width: E_p = 0.461 MeV ($s_{\frac{1}{2}}$), 1.748 MeV ($d_{\frac{3}{2}}$), and ≈6.7 MeV ($d_{\frac{5}{2}}$). A narrow $d_{\frac{5}{2}}$ resonance is observed at 4.808 MeV and an anomaly in the $d_{\frac{5}{2}}$ phase shift at ≈5.3 MeV. It is demonstrated by means of a coupled-channel calculation that these last two features are due to the resonance in the inelastic channel ($^{12*}C$ + p) corresponding to the 0.461-MeV s-wave resonance in the elastic channel. The experimental s- and d-wave phase shifts and damping parameters are accurately reproduced after adjustment of the depth of square-well potentials. The coupled-channel calculation also demonstrates that a resonance may be switched from one channel to another by changing the strength of the coupling. (auth)

23434 THEORY OF PION ABSORPTION APPLIED TO THE REACTION $^6Li(\pi^-,2n)^4He$. Koltun, D. S. (Univ. of Rochester, N. Y.); Reitan, A. Phys. Rev., 155: 1139-44(Mar. 20, 1967). (UR-875-165).

The absorption of pions from a low-energy S state, by a nucleus with the emission of two fast nucleons, is treated in an impulse approximation in which the pion interacts only with the pair of ejected nucleons. We consider the particular reaction $^6Li(\pi^-,2n)^4He$. The two-nucleon absorption process is given by a theory, previously applied to the pion absorption by a deuteron, which is developed from low-energy pion-nucleon scattering theory. The relative motion of the absorbing nucleon pair is treated in detail, including effects of short-range repulsion and tensor potentials. Distributions of the emitted nucleons in momentum and angle are calculated in this theory, and are compared with other results for some theories with experimental data. (auth)

23435 ELECTRIC QUADRUPOLE TRANSITIONS NEAR A = 16: THE LIFETIMES OF THE ^{16}N 0.120-, ^{18}F 1.125-, ^{19}F 0.197-, AND ^{19}Ne 0.241-MeV LEVELS. Becker, J. A. (Brookhaven National Lab., Upton, N. Y.); Olness, J. W.; Wilkinson, D. H. Phys. Rev., 155: 1089-95(Mar. 20, 1967). (BNL-10674).

Continuing a program to study E2 lifetimes in the neighborhood of A = 16, the mean lifetimes of the following states were remeasured: the 0.197-MeV level of ^{19}F; the 0.241-MeV level of ^{19}Ne; the 0.120-MeV level of ^{16}N; and the 1.125-MeV level of ^{18}F. Lifetimes were found to be $(129.9 \pm 2.3) \times 10^{-9}$ sec, $(26.6 \pm 1.2) \times 10^{-9}$ sec, $(7.58 \pm 0.09) \times 10^{-6}$ sec, and $(221 \pm 21) \times 10^{-6}$ sec, respectively. (auth)

23436 RELATIVE PHASES OF E2 AND M1 MATRIX ELEMENTS IN 1 p-SHELL NUCLEI. Polettti, A. R. (Brookhaven National Lab., Upton, N. Y.); Warburton, E. K.; Kurath, Dieter. Phys. Rev., 155: 1096-1104(Mar. 20, 1967). (BNL-10588).

The predictions of the independent-particle model for seven mixed E2-M1 gamma-ray transitions in the 1p-shell nuclei are compared with experiment. Agreement is excellent both for the M1 widths and for the E2/M1 mixing ratios if, in the latter case, collective enhancement of E2 transitions is included. This collective enhancement is discussed first in terms of effective charges, then in terms of perturbation theory in a Nilsson model. The seven transitions considered are ones for which the experimental results are especially reliable, and the theoretical results are relatively insensitive to details of the model. The main motive of this work was to compare the measured phases of the E2/M1 mixing ratios with theory. The agreement both for the absolute phases and the magnitudes was good enough to establish these seven transitions as standards for later consideration of the phases of E2/M1 mixing ratios for less well-understood transitions. Some general relations between E(L + 1)/ML and M(L + 1)/EL mixing ratios of corresponding transitions in conjugate nuclei are discussed. (auth)

23437 DECAY OF THE 9.49-, 9.53-, AND 9.60-MeV LEVELS OF ^{15}O. Evans, Albert E. (Naval Ordnance Lab., Silver Spring, Md.). Phys. Rev., 155: 1047-53(Mar. 20, 1967).

The $^{14}N(p,\gamma)^{15}O$ reaction was studied for proton energies from 1.85 to 2.60 MeV. Principal resonances occur at 2.352 ± 0.005 and 2.480 ± 0.005 MeV, corresponding to levels in ^{15}O at 9.487 and 9.606 MeV. In addition, there is known to be a level of approximate width 300 keV at an energy of approximately 9.53 MeV. The decay of these levels was studied using an anticoincidence-shielded NaI(Tl) spectrometer. Both of the sharp levels decay strongly to the ground state of ^{15}O, to the 5.24-MeV level, and weakly to the 6.18-MeV level. In addition, the 9.487-MeV level decays weakly to the 6.86- and 7.284-MeV levels. From the intensities and angular distributions of the ground-state transitions, it is concluded that the spin and parity of the 9.487-MeV level are $\frac{5}{2}^-$. The broad 9.53-MeV level decays almost entirely to the ground state. A search for gamma radiation from the level in ^{15}O reported at 9.67 MeV was unfruitful. (auth)

23438 $^{12}C(p,2p)^{11}B$ REACTION AT 50 MeV. Pugh, H. G. (Univ. of California, Berkeley); Hendrie, D. L.; Chabre, Marc; Boschitz, E.; McCarthy, I. E. Phys. Rev., 155: 1054-61(Mar. 20, 1967). (UCRL-16913).

The $^{12}C(p,2p)^{11}B$ reaction was studied at a bombarding energy of 50.0 ± 0.2 MeV with an energy resolution of 300 keV. Transitions were observed to the ground state and to the 2.14-, 4.46-, 5.04-, and 6.76-MeV excited states of ^{11}B. Angular correlation measurements were made in various coplanar geometrical arrangements. In the symmetric geometry, where the protons are detected at equal angles on either side of the incident beam direction, the angular correlation was measured from 15° to 115°. In an asymmetric geometry in which one detector was fixed at 30°, measurements were made as the other detector was moved between 15° and 100° on the other side of the beam direction. Both of the angular correlations are characterized by a general rise in the forward direction, modulated by a diffractionlike structure, when only those events are selected in which the energies of the selected protons are equal. The results of a distorted-wave analysis are presented and discussed. The formation of the 4.46-MeV ($\frac{5}{2}^-$) and 6.76-MeV ($\frac{1}{2}^-$) states is discussed in terms of the ejection of a proton from the 1f shell in ^{12}C and, more attractively, in terms of a two-stage process involving both the ejection of a 1p-state proton and a core excitation. (auth)

23439 EXCITATION OF A 19-MeV LEVEL IN ^{12}C BY INELASTIC ELECTRON SCATTERING. Crannell, Hall (Stanford Univ., Calif.); Dahl, Harvey A.; Lewis, F. H. Jr. Contract Nonr 225(67). Phys. Rev., 155: 1062-5(Mar. 20, 1967).

Measurements of inelastic-electron-scattering cross sections for ^{12}C have been made for transitions to a level at approximately 19.5 MeV. The cross-section peak corresponding to excitation of this level is clearly visible above the inelastic continuum over the range of momentum transfers from 267 to 643 MeV/c at electron-scattering angles between 40° and 48°. Form factors derived from the experimental data are compared with theoretical form factors calculated by assuming the excitation involves a single-particle-dipole transition to a T = 1, J = 1⁻ state. A search for levels with higher excitation energies was also undertaken, special attention being focused on the region 30 to 45 MeV. This failed to uncover, within the experimental sensitivity, any levels with excitation energy greater than 20 MeV. (auth)

23440 THE $^6Li(d,\alpha)^4He$ REACTION WITH POLARIZED DEUTERONS. Buergisser, H.; Baumgartner, E.; Benenson, R. E.; Michel, G.; Seiler, F.; Striebel, H. R. (Univ., Basel). Helv. Phys. Acta, 40: 185-96(1967). (In German).

The sensitivity of the $^{6}Li(d,\alpha)^{4}He$ reaction to deuteron vector and tensor polarization was measured at 600 keV. The different orientations and the magnitude of the incident polarization used were concurrently monitored by the $T(d,n)^{4}He$ reaction. Both the magnitude and the angular dependence of the sensitivities show that the 23-MeV level in ^{8}Be is a 2^{+} state, predominantly formed by incident l = 0. Deviations from pure S-wave behavior are consistent with an admixture of l = 2 channels leading to the same state. (auth)

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Refer also to abstracts 22992, 23238, 23271, 23273, 23414, 23479, 23484, 23519, 23534, 23545, and 23556.

23441 (KFK-120) NEUTRON CROSS SECTIONS FOR FAST REACTOR MATERIALS. PART I. EVALUATION. Schmidt, J. J. (Kernforschungszentrum, Karlsruhe (West Germany). Institut fuer Neutronenphysik und Reaktortechnik). Feb. 1966. 1317p. Dep. mn.

A compilation of neutron cross sections and resonance parameters for C, Cr, He, H, Fe, Mo, Ni, O, ^{239}Pu, Na, ^{235}U, and ^{238}U is presented. The techniques that were used in the analyses of the data are described. Neutron energies in the range from 0.01 eV to 10 MeV are covered. (D.C.W.)

23442 (ANL-Trans-462) ELASTIC SCATTERING OF POLARIZED 4 MeV NEUTRONS BY MEDIUM AND HEAVY NUCLEI. Gorlov, G. V.; Lebedeva, N. S.; Morozov, V. M. (Gosudarstvennyi Komitet po Ispol'zovaniyu Atomnoi Energii SSSR, Moscow, Institut Atomnoi Energii). Translated by Elmar K. Wilip (Argonne National Lab., Ill.), from report IAE-1251. 6p. Dep. CFSTI. JCL $1.10 fs, $0.80 mf.

Results from calculations with parameters of the optical nuclear model chosen on the basis of data obtained on the elastic scattering of polarized 4-MeV neutrons by the nuclei ^{59}Co, ^{60}Ni, ^{80}Se, ^{93}Nb, ^{114}Cd, ^{115}In, ^{118}Sn, ^{127}I, Pb, and ^{209}Bi within the angular range of 10 to 170° are compared with the initial data and are used in the analysis of experiments on the elastic scattering of the same polarized neutrons by the nuclei Cu, In, Sn, Pb, Bi, and U at the angles 2 to 21°. It suffices for the description of the last experiment to assume the existence of only nuclear and Coulomb scattering. (auth)

23443 (BNL-tr-50) CROSS SECTIONS OF RADIATIVE CAPTURE OF FAST NEUTRONS IN IRON. Malishev, A. V.; Stavisskii, Yu. Ya.; Shapar, A. V. Translated by Stephen J. Amoretty (Brookhaven National Lab., Upton, N. Y.), from At. Energ. (USSR), 17: 508-9(1964). 5p. Dep. mn. CFSTI $3.00 cy, $0.65 mn. JCL $1.10 fs, $0.80 mf.

Neutron capture cross sections were measured for a natural mixture of Fe isotopes at neutron energies of 1.0, 1.2, and 1.4 MeV. The data, together with some previous data for energies of 0.03 to 0.9 MeV, were compared with calculations of the radiative capture cross section of ^{56}Fe by the statistical theory. Cross sections for ^{54}Fe, ^{57}Fe, and natural Fe were also evaluated for a neutron energy of 1.345 MeV. (D.C.W.)

23444 NEW VALUE FOR THE ^{55}Mn NUCLEAR MAGNETIC MOMENT. Mims, W. B. (Bell Telephone Labs., Murray Hill, N. J.); Devlin, G. E.; Geschwind, S.; Jaccarino, V. Phys. Lett., 24A: 481-2(Apr. 24, 1967).

The magnetic moment of ^{55}Mn was determined by ENDOR experiments on Mn^{2+} in $CaWO_4$, CaO, and ZnS. A new value of $^{55}\mu = 3.4438 \pm 0.0020\ \mu_n$ is assigned. (auth)

23445 FLUCTUATIONS IN THE INTEGRATED CROSS SECTION OF THE REACTION $^{45}Sc(p,n)^{45}Ti$. Iyengar, K. V. K. (Tata Inst. of Fundamental Research, Bombay); Gupta, S. K.; Sekharan, K. K.; Mehta, M. K.; Divatia, A. S. Nucl. Phys., A96: 521-8(1967).

The integrated cross section of the reaction $^{45}Sc(p,n)^{45}Ti$ as a function of incident proton energy was measured in the energy interval 2.910 to 5.250 MeV with energy steps of 5 keV. The overall energy resolution was about 3.5 keV. The excitation function shows fluctuations around an average. This average increases with proton energy. The statistical theory of Ericson was applied; the autocorrelation was calculated and used to determine the average width of levels in the compound nucleus ^{46}Ti in the excitation energy range 13.230 to 15.140 MeV. The analysis yields an average width $\langle\Gamma\rangle$ of 6 keV corresponding to a compound nucleus lifetime of 1.1×10^{-7} psec. (auth)

23446 COMPARISONS BETWEEN SENIORITY, QUASI-PARTICLE AND SHELL-MODEL CALCULATIONS IN EVEN NICKEL ISOTOPES. Hsu, L. S. (Univ. of Rochester, N. Y.). Nucl. Phys., A96: 624-40(1967). (UR-875-149).

Using the even Ni isotopes as an example, the accuracy of various approximation methods for systems involving identical nucleons was studied by direct comparison with an exact shell-model calculation. The $\nu 4$ approximation in which a truncated shell-model space was used involving states with seniority not exceeding 4, and the PTD4 approximation in which a number-projected Tamm–Dancoff approximation was made with not more than four quasi-particles are found to have satisfactory accuracy for the low-lying states. Beyond this, the possibility of the existence of a two-phonon or of a double-excitation structure (in which the excitation operator is the square of a hole-particle excitation) was studied. The 2^{+} and 4^{+} members of the two-phonon or doubly excited states can be roughly identified with some low-lying eigenstate, but this is not true for the 0^{+} two-phonon state for which the centroid energy is high and the width large. The double-excitation 0^{+} state can be well identified with a low-lying shell model 0^{+} state. (auth)

23447 A MOESSBAUER STUDY OF THE HYPERFINE SPECTRUM OF ^{57}Fe, USING ULTRASONIC CALIBRATION. Cranshaw, T. E. (Atomic Energy Research Establishment, Harwell, Eng.); Reivari, P. Proc. Phys. Soc. (London), 90: 1059-64(Apr. 1967).

Experiments on an absorber vibrated at ultrasonic frequency are described. The spectrum is used to calibrate the spectrometer for a measurement of the ^{57}Fe hyperfine spectrum, and it is found that the hyperfine fields in the bulk iron and in the domain walls are equal to within 0.1%. (auth)

23448 A MEASUREMENT OF THE NUCLEAR POLARIZATION IN THE REACTION $^{40}Ca(d,p)^{41}Ca^{*}$ (1.95 MeV). Freiberg, E.; Hoenig, V.; Kleiser, J.; Soergel, V. (Univ., Freiburg i. B.). Nucl. Phys., A96: 696-704(1967).

A measurement of the circular polarization of the γ-rays, emitted perpendicular to the reaction plane in the reaction $^{40}Ca + d \rightarrow {}^{41}Ca + p + \gamma$ (1.95 MeV) is described. For the three angles of proton emission, $\theta_p = 22.5°$, 35°, 75°, the experiment gave the respective values of γ-ray polarization $P_\gamma = +3 \pm 16\%$, $+26 \pm 12\%$, and $-39 \pm 14\%$. These polarizations agree with the result of a spin-independent DWBA calculation of Tobocman and Gibbs. (auth)

23449 STUDY OF THERMAL NEUTRON CAPTURE IN SULFUR. Kennett, T. J.; Archer, N. P.; Hughes, L. B. (McMaster Univ., Hamilton, Can.). Nucl. Phys., A96: 658-70(1967).

The $^{32}S(n,\gamma)^{33}S$ reaction was studied using a Ge(Li) and a Ge(Li)-NaI(Tl) spectrometer. The principal aim was to establish a set of accurate energies for high-energy gamma-ray standards. In order to employ energy loops for consistency checks, a coincidence experiment was also conducted. The neutron separation energy was determined to be 8646 ± 1 keV for ^{33}S and 6988 ± 2 keV for ^{35}S and the energies of virtually all the transitions observed are accurate to 2 keV. The two parameter coincidence experiment revealed the presence of a strong 4640 to 2348 keV cascade belonging to the $^{34}S(n,\gamma)^{35}S$ reaction. (auth)

23450 ELASTIC SCATTERING OF 6 TO 12 MeV DEUTERONS BY ^{48}Ti. Siemssen, R. H.; Mayer-Boericke, C. (Argonne National Lab., Ill.). Nucl. Phys., A96: 505-12(1967).

Angular distributions of deuterons elastically scattered from ^{48}Ti were measured in 1-MeV steps from 6 to 12 MeV, and the data were analyzed by the nuclear optical model. The optical-model parameters were found to vary smoothly with energy. Good fits were obtained with an average set of parameters. No anomalous energy dependence of the optical-model parameters V and W was found. (auth)

23451 SCATTERING OF POLARIZED PROTONS BY NEON. Bem, P.; Habanec, J.; Karban, O.; Nemec, J. (Inst. of Nuclear Research, Czechoslovak Academy of Sciences, Rez). Nucl. Phys., A96: 529-38(1967).

The polarization and cross sections of protons scattered on a neon target were measured between 3.9 and 5.1 MeV. The data were interpreted in terms of non-resonant scattering combined with resonant scattering from four states of the compound system. Spins and parities $J^{\pi} = 3/2^{+}$, $(5/2^{+})$, $1/2^{+}$ and $5/2^{+}$ could be assigned to the ^{21}Na levels at 6.52, 6.92, 7.21 and 7.45 MeV, respectively. (auth)

23452 LEVELS OF ^{32}S STUDIED BY THE $^{31}P(p,\alpha_0)^{28}Si$ REACTION. Riley, P. J.; Lock, G. A.; Rawlins, J. A.; Shin, Y. M. (Univ. of Texas, Austin). Nucl. Phys., A96: 641-57(1967). (ORO-2972-9)

Differential cross sections were measured for the $^{31}P(p,\alpha_0)^{28}Si$ reaction between $E_p = 1$ and 5.5 MeV. A total of 78 resonances was observed. Analysis of the angular distributions, measured at 36 of the lower energy resonances, has allowed unique spin and parity assignments to be given in 18 cases. Limits were evaluated for the reduced proton and alpha particle widths for the 36 resonances. The observed level densities are shown to be in good agreement with those predicted from theory. (auth)

23453 POLARIZATION EXCITATION OF THE 1.85-MeV RESONANCES IN $^{40}Ar(p,p)^{40}Ar$. Brown, Louis (Carnegie Institution of Washington, Washington, D. C.); Traechslin, Walter. Nucl. Phys., A96: 238-40(1967).

Recent high resolution measurements of the excitation function in the elastic scattering of protons by argon show the region around E_p = 1.87 MeV to be made up of several narrow resonances. The cross-section measurements identify the states as p-wave but allow no certain establishment of spin. Measurements are reported of polarization at a fixed lab angle of 135° in 10-keV steps from 1.83 to 1.93 MeV with a target of 15-keV thickness. These experimental conditions average the effects of the several states until they appear almost as a single level. Calculations of the polarization as a function of energy, using the single-level formula and Rosen's optical parameters, show that the overall structure behaves as if from $p_{\frac{1}{2}}$ protons. (auth)

23454 THE SPIN OF THE 974-keV LEVEL IN ^{28}Al. Lawergren, B. (Atomic Energy Research Establishment, Harwell, Eng.). Nucl. Phys., A96: 49-51(1967).

The $^{30}Si(d,\alpha)^{28}Al$ reaction leading to the seven lowest levels in ^{28}Al was studied. The measured yields indicate zero angular momentum of the 974-keV level although a $J^\pi = 1^-$ assignment is not completely ruled out. (auth)

23455 LOW-LYING LEVELS OF ^{79}Br. Robinson, R. L.; McGowan, F. K.; Stelson, P. H.; Milner, W. T. (Oak Ridge National Lab., Tenn.). Nucl. Phys., A96: 6-32(1967). (ORNL-P-2791).

The properties of the low-lying levels of ^{79}Br were investigated by means of the Coulomb excitation process which was effected by the bombardment of a thick target of $PbBr_2$ (isotopically enriched to 95.1% in ^{79}Br) with 2.5 to 7.0 MeV alpha particles and with 36 MeV oxygen ions. In the ensuing singles and coincidence gamma spectra, peaks attributed to ^{79}Br were observed at 43 ± 3, 136.1 ± 1.1, 208.4 ± 0.6, 217.3 ± 0.3, 238.6 ± 0.4, 261.5 ± 0.3, 299.4 ± 0.7, 306.4 ± 0.3, ≈307 or ≈216, 389.1 ± 0.6, 397.2 ± 0.3, 522.8 ± 0.3, 544.0 ± 0.4, 605.4 ± 0.5 and 760.5 ± 0.8 keV. The changes in gamma yields with alpha-particle energy were compatible with those predicted for E2 Coulomb excitation. The $B(E2)_{ex}$ values were determined from these yields. Angular anisotropies were measured for the stronger transitions to aid in the assignment of spins. Additional information was obtained about the ^{79}Br level properties through an investigation of gamma rays following the decay of ^{79}Kr. The energies, spins, parities, and reduced E2 transition probabilities obtained for the levels of ^{79}Br are given. The B(M1) values which were estimated for 16 of the gamma transitions, had values ranging from 0.002 to ≈0.5 $(e\hbar/2Mc)^2$. (auth)

23456 FERMI MATRIX ELEMENTS IN ALLOWED BETA TRANSITIONS IN ^{56}Co, ^{58}Co, AND ^{134}Cs. Bhattacherjee, S. K.; Mitra, S. K.; Padhi, H. C. (Tata Inst. of Fundamental Research, Bombay). Nucl. Phys., A96: 81-96(1967).

The angular-correlation asymmetry parameter for circularly polarized γ rays following allowed β decay was measured for three nuclei: ^{56}Co, ^{58}Co and ^{134}Cs. The polarimeter employed the usual forward Compton scattering of γ rays. The measured asymmetry parameter, A, and the Fermi matrix element, M_F, in these decays are given. The presently available data on the measurements of the Fermi matrix element M_F in different regions of the periodic table are reviewed in the light of isospin impurities of nuclear wave functions. (auth)

23457 CORIOLIS COUPLING BETWEEN ROTATIONAL BANDS IN THE NUCLEUS ^{57}Fe. Sood, P. C.; Hutcheon, D. A. (Univ. of Alberta, Edmonton). Nucl. Phys., A96: 159-72(1967).

The first five levels of ^{57}Fe are considered to be the members of two rotational bands with $K = \frac{1}{2}$ and $K = \frac{3}{2}$ which are admixed due to Coriolis coupling. A reasonable set of rotational parameters are found to give an exact agreement with the energies of all known levels below 1-MeV excitation and to yield a fairly well-defined Nilsson model potential. The other single-particle levels in this potential are compared with higher levels. The single-particle wave functions are used to calculate the magnetic moments, quadrupole moments, and M1 and E2 reduced transition probabilities for the low-lying levels. The model is found to give a fair description of all these properties. (auth)

23458 NON-EXISTENCE OF A LEVEL AT 1.35-MeV IN ^{33}S. Moss, C. E. (California Inst. of Tech., Pasadena). Nucl. Phys., A96: 1-5(1967).

A natural sulphur target was bombarded with 2.541-MeV deuterons, and the emitted protons were observed with a magnetic spectrometer. The peak tentatively attributed earlier to a level at an excitation energy of 1.35 in ^{33}S is shown to be due to levels in ^{34}S at excitation energies of 4.08 and 4.12 MeV. (auth)

23459 THE STUDY OF THE $^{51}V(p,n)^{51}Cr$ REACTION. Iyengar, K. V. K.; Gupta, S. K.; Lal, B. (Tata Inst. of Fundamental Research, Bombay). Nucl. Phys., A96: 417-39(1967).

The excitation functions of the 0.75, 1.17, 1.35, and 1.50 plus 1.56 MeV gamma rays resulting from the $^{51}V(p,n)^{51*}Cr$ reaction were measured from their respective thresholds up to 5.5 MeV. They all vary smoothly with proton energy and exhibit no significant structure. The ratio of the measured yield of 0.75-MeV gamma rays to that of 1.17-MeV gamma rays as a function of incident proton energy is compared with the ratio predicted by the Hauser-Feshbach theory, and the spin of the levels was deduced to be $\frac{3}{2}$ and $\frac{5}{2}$, respectively. The n_1-0.75 MeV gamma and n_2-1.17 MeV gamma angular correlations were measured at proton energies 3.1, 3.3, and 3.5 MeV in the plane of the reaction and at 3.1 and 3.3 MeV in the plane perpendicular to it. The shapes of the measured correlations are not in complete agreement with the predictions of the compound nucleus statistical model and seem to indicate either the preponderance of a cluster of compound nucleus levels or some interference effect. (auth)

23460 THE LOW-LYING STATES OF ^{23}Mg. Da Silva, M. F.; Kossionides, S.; Lisle, J. C.; Da Silva, C. M. (Univ. of Manchester, Eng.). Nucl. Phys., A97: 337-52(1967).

The levels below 3 MeV in ^{23}Mg were excited by the reaction $^{24}Mg(^3He,\alpha)^{23}Mg$, and properties of these levels were inferred from α-γ angular correlation measurements. Firm spin assignments of $\frac{1}{2}$ and $\frac{7}{2}$ for the first and second excited states, respectively, were made using the present data in conjunction with the available information on ^{23}Na. The spin values for the third and sixth excited states were limited to $(\frac{1}{2},\frac{3}{2})$ and $\frac{3}{2}$, $(\frac{5}{2})$, respectively. Multipole mixing ratios of the de-excitation gamma-rays from these levels and branching ratios for the first six levels in ^{23}Mg were deduced. These results and the available experimental information on ^{23}Na are compared with the Nilsson model predictions. (auth)

23461 A STUDY OF THE LEVELS OF ^{49}Ti, ^{52}Cr, AND ^{56}Fe USING (p,α) REACTIONS. Brown, G.; Haigh, J. G. B.; MacGregor, A. E. Nucl. Phys., A97: 353-77(1967).

Angular distributions of alpha-particle groups from the reactions $^{51}V(p,\alpha)^{48}Ti$, $^{55}Mn(p,\alpha)^{52}Cr$, and $^{59}Co(p,\alpha)^{56}Fe$ were studied at incident energies of around 12 MeV. The yields from these reactions to the low-lying levels of the residual nuclei are interpreted using Hauser-Feshbach compound-nucleus theory. A comparison is also made with the yields of the $^{52}Cr(p,p')^{52}Cr$, $^{56}Fe(p,p')^{56}Fe$, and $^{49}Ti(p,p')^{49}Ti$ reactions. Some new information is obtained on the spins of levels of ^{48}Ti, ^{52}Cr, and ^{56}Fe. (auth)

23462 $(^3He,\alpha)$ REACTION ON ^{64}Zn AND ^{70}Ge. Fou, C. M.; Zurmuehle, R. W.; Joyce, J. M. (Univ. of Pennsylvania, Philadelphia). Nucl. Phys., A97: 458-68(1967).

The low-lying levels in ^{63}Zn and ^{69}Ge were studied by the $^{64}Zn(^3He,\alpha)^{63}Zn$ and $^{70}Ge(^3He,\alpha)^{69}Ge$ reactions at 18 MeV. Angular distributions of α particles leading to strong states in ^{63}Zn and ^{69}Ge up to 7-MeV excitation energy were measured using solid-state detectors. Optical-model potential parameters determined from the analysis of the $^{64}Zn(^3He,^3He)^{64}Zn$ angular distribution were used in the DWBA analysis. The following spin and parity assignments are made for ^{63}Zn: ground state, $\frac{3}{2}^-$; 0.19-MeV state, $\frac{1}{2}^-$; 0.64-MeV state, $(\frac{3}{2}^-,\frac{1}{2}^-)$; 1.64-MeV state, $(\frac{5}{2}^-)$; 2.60-MeV state, $(\frac{1}{2}^-)$; 3.28-MeV state, $(\frac{1}{2}^-)$; 5.42 MeV state, $(\frac{1}{2}^-)$; 6.80-MeV state, $(\frac{5}{2}^-)$ for ^{69}Ge: ground state, $\frac{3}{2}^-$; 0.09-MeV state, $(\frac{5}{2}^-)$; 0.23-MeV state, $(\frac{3}{2}^-,\frac{1}{2}^-)$; 0.38-MeV state, $\frac{1}{2}^-$; 1.00-MeV state, $(\frac{3}{2}^-,\frac{1}{2}^-)$; 7.00-MeV state, $\frac{7}{2}^-$. The 5.42- and 6.80-MeV states in ^{63}Zn are probably analog states of the ground state and 1.42-MeV state in ^{63}Cu. The 7.00-MeV state in ^{69}Ge is identified as the analog state of the ground state in ^{69}Ga. Spectroscopic factors were extracted. The result shows that the neutron occupation numbers of the $p_{\frac{3}{2}}$, $f_{\frac{5}{2}}$ and $p_{\frac{1}{2}}$ levels in ^{64}Zn and ^{70}Ge are approximately 2, 3, 1 and 4, 4, 1, respectively. (auth)

23463 ^{64}Ga SPIN FROM β-γ(CP) CORRELATION DATA AND DECAY TO ^{64}Zn LEVELS. Mann, L. G.; Tirsell, K. Glenn; Bloom, S. D. (Univ. of California, Livermore). Contract W-7405-eng-48. Nucl. Phys., A97: 425-43(1967). (UCRL-70239).

The decay of 2.6-min ^{64}Ga produced by the reaction $^{64}Zn(p,n)^{64}Ga$ was studied by Ge(Li) γ-ray spectroscopy, NaI(Tl) crystals both singly and in coincidence, and β-γ(CP) correlation measurements. A transmission type of polarimeter was used in the correlation measurements to give good discrimination against lower energy γ rays. The decay was found to populate excited states in ^{64}Zn at 991.3, 1799.2, 1909.8, 2608.5, 3186.2, 3261.7, 3365.9, 3425.0, 3795.0, 4453.5 keV, and possibly 3623 keV. The decay properties of these states were generally found to agree well with the $(p,p'\gamma)$ work of Van Patter and co-workers. Beta-gamma (CP) correlation measurements were made on β rays in coincidence with strong ground-state γ-ray transitions from the states at 3365.9 and 3425.0

keV. The combined asymmetry parameter of -1.00 ± 0.05 strongly favors a spin of 0 for the ^{64}Ga ground state; a spin of 1 would be possible only if the mixing into the ^{64}Ga ground state involves a very large Coulomb matrix element of $\gtrsim$344 keV. Possible explanations of the unusually large Coulomb matrix element (35 keV) between the analog of the ^{64}Zn ground state and the ^{64}Ga ground state are discussed. (auth)

23464 APPLICATION OF THE SUPERFLUIDITY MODEL TO LIGHT NUCLEI. Shaker, M. O.; Kresnin, A. A. (Atomic Energy Establishment, Cairo). Nucl. Phys., A97: 469-74(1967).

The superfluid nuclear model is applied to deformed nuclei in the 2s-1d shell. Moments of inertia of ^{24}Mg and ^{28}Si calculated within the framework of the superfluid model are in good agreement with experimental values. It is shown that the considered model may be used as a tool for defining the deformation parameters of nuclei in regions where a transition from prolate to oblate deformation occurs. (auth)

23465 CONTRIBUTION TO THE STUDY OF THE DOUBLET OF LEVELS AT 6.88 MeV IN ^{28}Si. Gorodetzky, S.; Coffin, J. P.; Frick, G.; Gallmann, A.; Jundt, F.; Aslanides, E. (Institut de Recherches Nucleaires, Strasbourg). Nucl. Phys., A97: 475-80 (1967). (In French).

Using a Ge(Li) gamma-ray detector and a magnetic pair spectrometer changed into a "multipole meter," gamma rays from ^{28}Si were studied. The results show that in the doublet at 6.88 MeV, the excitation energy of the level 6.88^a MeV, which decays primarily to the ground state, is lower than that of the other level 6.88^b MeV, which decays essentially to the 1.78-MeV first excited state. The study with the "multipole meter" of the 6.88^a MeV $\rightarrow$ 0 transition shows that this transition is probably E3. Consequently this level probably has $J^\pi = 3^-$. (auth)

23466 SPIN DETERMINATIONS OF NEUTRON RESONANCES IN Sb, Ta, Re, AND Ir, USING IRON-ALLOY TARGETS. Stolovy, A. (Naval Research Lab., Washington, D. C.). Phys. Rev., 155: 1330-3(Mar. 20, 1967).

The spin assignments of 14 low-energy neutron resonances in Sb, Ta, Re, and Ir were made by observing the transmission of polarized neutrons through polarized targets. The nuclei of diamagnetic atoms were polarized by dissolving them in iron, placing the alloy in a magnetic field, and reducing the temperature below 0.1°K. No correlation was found between the resonance spin states and the total radiation widths. Information was obtained on the magnitude and direction of the hyperfine fields at the solute nuclei. (auth)

23467 LIFETIMES OF THE LEVELS AT 265 AND 280 keV IN ^{75}As. Langhoff, H.; Schumacher, M. (Franklin Inst., Swarthmore, Pa.). Phys. Rev., 155: 1246-8(Mar. 20, 1967). (NYO-3525-10).

The centrifuge technique was applied to observe resonance fluorescence from the levels at 265 and 280 keV in ^{75}As. Using a Li-drifted germanium detector, it was possible to separate the two resonance lines completely. The resulting mean lifetimes are $\tau_{265} = (1.71 \pm 0.10) \times 10^{-11}$ sec and $\tau_{280} = (4.02 \pm 0.30) \times 10^{-10}$ sec. The angular distributions of the resonantly scattered radiations yielded M1-E2 mixing ratios of $\delta_{265} = -(0.01 \pm 0.04)$ and $\delta_{280} = -(0.42 \pm 0.08)$, in agreement with previous results. (auth)

23468 SINGLE-NEUTRON-HOLE STATES IN ^{89}Zr FROM THE ^{90}Zr(^{3}He,α)^{89}Zr REACTION AT 18 MeV. Fou, C. M.; Zurmuehle, R. W.; Joyce, J. M. (Univ. of Pennsylvania, Philadelphia). Phys. Rev., 155: 1248-53(Mar. 20, 1967).

The (^{3}He,α) single-neutron pickup reaction was studied in ^{90}Zr at 18 MeV using solid-state detectors. The reaction Q value was determined to be 8.58 ± 0.05 MeV. Levels observed in this reaction are the ground state, the 0.59-, 1.07-, 1.44-, 1.72-, 1.84-, 2.06-, and 8.10-MeV states. Angular distributions of all these states except the 8.10-MeV state were measured from 10° to 100° in 5° steps. Distorted-wave Born-approximation analysis (DWBA) yielded the following l-value assignments: ground state, l = 4; 0.59-, 1.07-, and 1.84-MeV states, l = 1; 1.44- and 2.06-MeV states, l = 3; 1.72-MeV state, possibly l = 3. Relative spectroscopic factors were extracted. The 8.10-MeV state was identified as the analog state of the ground state of ^{89}Y. Its angular distribution was measured from 10° to 50° and was in agreement with a $\frac{1}{2}^-$ spin assignment. The Coulomb displacement energy was calculated to be 11.70 ± 0.05 MeV. The ratio of the spectroscopic factors of the T> and the T< states is discussed in connection with the DWBA predictions. The locations of the single-neutron-hole states are investigated. (auth)

23469 (^{4}He,t) REACTION ON MEDIUM-WEIGHT NUCLEI. Armstrong, D. D. (Los Alamos Scientific Lab., N. Mex.); Blair, A. G.; Thomas, H. C. Phys. Rev., 155: 1254-60(Mar. 20, 1967). (LA-DC-7723).

A 26.7-MeV beam of ^{4}He ions from the Los Alamos variable-energy cyclotron was used to study the (^{4}He,t) reaction on ^{52}Cr, ^{54}Fe, ^{56}Fe, ^{58}Fe, ^{59}Co, ^{60}Ni, ^{62}Ni, and ^{64}Ni. Angular distributions of tritons from the more strongly excited states of the residual nuclei were obtained over the angular range of $11° \lesssim \theta_{c.m.} \lesssim 48°$. There are marked differences between distributions from $\frac{3}{2}^-$ states and $\frac{1}{2}^-$ states, and between distributions from $\frac{1}{2}^-$ states and $\frac{5}{2}^-$ states. The behavior of the distributions also appears to depend strongly upon the Q of the reaction. The experimental results are compared to the predictions of a spin-independent distorted-wave calculation. Although such a calculation cannot reproduce the j-dependent behavior of the distributions, the extracted spectroscopic factors are usually in acceptable agreement with those obtained from recent (^{3}He,d) reaction studies on these nuclides, and thus a meaningful comparison of the results from the (^{4}He,t) and (^{3}He,d) reaction studies can be made. This provides evidence that under the conditions of the studies, core-excitation mechanisms are relatively unimportant. (auth)

23470 EVIDENCE FOR TARGET-EXCITATION EFFECTS IN A SINGLE-PARTICLE-TRANSFER REACTION. Dehnhard, D.; Yntema, J. L. (Argonne National Lab., Ill.). Phys. Rev., 155: 1261-3(Mar. 20, 1967).

The transitions to the $\frac{1}{2}^+$ and $\frac{5}{2}^+$ states in ^{25}Mg were measured with both the ^{26}Mg(^{3}He,α)^{25}Mg and ^{26}Mg(d,t)^{25}Mg reactions. The only angular distribution that is fitted reasonably well by distorted-wave Born-approximation calculations is the ^{26}Mg(^{3}He,α)^{25}Mg transition to the $\frac{1}{2}^+$ state. The larger cross section for the $\frac{1}{2}^+$ transition in the (^{3}He,α) reaction, and the differences between the shapes of the angular distributions of the transitions to the $\frac{1}{2}^+$ and $\frac{5}{2}^+$ states suggest strongly that the $\frac{1}{2}^+$ is excited primarily by a multiple-excitation process, while interference effects between the simple single-nucleon transfer and multiple excitation may be more important in the $\frac{5}{2}^+$. (auth)

23471 TRITON ELASTIC SCATTERING. Hafele, J. C.; Flynn, E. R.; Blair, A. G. (Los Alamos Scientific Lab., N. Mex.). Phys. Rev., 155: 1238-45(Mar. 20, 1967). (LA-DC-8312).

Differential cross sections for 15- and 20-MeV tritons elastically scattered from ^{52}Cr and ^{62}Ni and 20-MeV tritons from ^{64}Ni, ^{90}Zr, and ^{116}Sn are reported. The data are in good agreement with optical-model calculations using standard Woods-Saxon potential wells. The derived optical parameters are considered useful in distorted-wave calculations for reactions involving tritons and also indicate physical features of the triton interaction. (auth)

23472 GAMMA-RAY SPECTRA OF ^{60}Co AND ^{56}Mn FOLLOWING RESONANCE-NEUTRON CAPTURE IN ^{59}Co AND ^{55}Mn. Prestwich, W. V.; Cote, R. E. (Argonne National Lab., Ill.). Phys. Rev., 155: 1223-9(Mar. 20, 1967).

The gamma-ray spectra resulting from neutron capture in the 132-eV resonance of ^{59}Co and the 336-, 1098-, and 2355-eV resonances of ^{55}Mn were observed with a Ge(Li) spectrometer at the Argonne fast-chopper time-of-flight system. The spectra are compared with the thermal-capture spectra and with the proton spectra observed in deuteron stripping. The reduced gamma-ray width for transitions in ^{60}Co exhibit a dependence on the l_n value of the corresponding (d,p) transitions. The thermal and two higher-energy resonance spectra in ^{56}Mn display significant correlation with the corresponding stripping strengths. No such correlation was observed for the 132-eV resonance in ^{59}Co or the 336-eV resonance in ^{55}Mn. (auth)

23473 VIOLATION OF SENIORITY IN THE REACTION ^{43}Ca(d,p)^{44}Ca. Bjerregaard, J. H.; Hansen, Ole (Univ of Copenhagen). Phys. Rev., 155: 1229-37(Mar. 20, 1967).

The reaction ^{43}Ca(d,p)^{44}Ca was studied at 4 and 8.50 MeV bombarding energies. In the higher energy experiment, proton angular distributions were measured for 31 transitions, by means of the Aldermaston multiangle spectrograph. The l_n values and spectroscopic strengths were obtained from a distorted-wave analysis of the angular distributions. Energy levels were determined in the 4-MeV experiment by detecting the protons in the Copenhagen heavy-particle spectrograph. A ground-state Q value of 8920 ± 10 keV was obtained. The spectroscopic strengths were analyzed in terms of the non-energy-weighted sum rules for multipole orders $\lambda = 0$, 1, and 2. Eight $f_{\frac{7}{2}}$ transitions were observed, compared with four predicted by the seniority-coupling scheme. (auth)

23474 INELASTIC SCATTERING OF ^{3}He IONS AT INTERMEDIATE ENERGIES. Gibson, E. F. (Univ. of Colorado, Boulder); Kraushaar, J. J.; Ridley, B. W.; Rickey, M. E.; Bassel, R. H. Phys. Rev., 155: 1208-22(Mar. 20, 1967). (UCOL-535-560).

The inelastic scattering of ^{3}He ions from ^{40}Ca, ^{56}Fe, and ^{58}Ni was studied at a bombarding energy of 37.7 MeV, and the scattering from ^{89}Y and ^{90}Zr was investigated using 43.7-MeV ^{3}He ions.

The distorted-wave theory, using the optical parameters derived previously, gave an adequate description of the data on the collective model, provided both real and imaginary potentials were assumed to be deformed. Angular-momentum transfers and deformation parameters are in general agreement with those obtained from other experiments. (auth)

23475 ELASTIC SCATTERING OF ^{3}He IONS AT INTERMEDIATE ENERGIES. Gibson, E. F. (Univ. of Colorado, Boulder); Ridley, B. W.; Kraushaar, J. J.; Rickey, M. E.; Bassel, R. H. Phys. Rev., 155: 1194-1207(Mar. 20, 1967). (UCOL-535-559).

The elastic scattering of ^{3}He ions was studied at 37.7 MeV from ^{40}Ca, ^{56}Fe, and ^{58}Ni and at 43.7 MeV from ^{58}Ni, ^{89}Y, and ^{90}Zr. A theoretical analysis has been carried out in terms of the optical model. Both discrete and continuous ambiguities in the optical-model parameters appear, and are discussed in some detail. An average potential was selected which adequately accounts for our data as well as some reaction data of others. In the case of ^{40}Ca and ^{58}Ni, the energy dependence of the real and imaginary well depths was investigated using a standard geometry. Similarly, the A dependence of the well depths was examined. (auth)

23476 LEVEL STRUCTURE AND DECAY SCHEME OF ^{43}Sc. Schwartz, J. J. (Univ. of Rochester, N. Y.); Alford, W. P.; Braid, T. H.; Meyer-Schuetzmeister, L. Phys. Rev., 155: 1191-4(Mar. 20, 1967).

The ^{40}Ca(α,p)^{43}Sc and ^{40}Ca(α,pγ)^{43}Sc reactions have been used to study the level structure and decay scheme of ^{43}Sc from the ground state through 1.95 MeV in excitation. Previously unreported doublets are observed with energies of (1.418, 1.426) and (1.810, 1.826) MeV. There is some indication that a third doublet may lie at (0.846, 0.855) MeV. On the basis of the decay scheme, it is suggested that the levels at 1.810 and 0.475 MeV have spin $\frac{3}{2}$. (auth)

23477 SOME OF THE IMPORTANT RESULTS OBTAINED IN THE CYCLOTRON LABORATORY. Martalogu, N. (Inst. of Atomic Physics, Bucharest). Stud. Cercet. Fiz., 18: 901-2 (1966). (In Rumanian).

The mechanism of (p,p) and (p,p′) reactions involving light nuclei was studied in order to clarify the structure of the nucleus. The compensation effect in the excitation functions of elastic and inelastic scattering of 5.2- to 6.2-MeV protons on ^{20}Ne was observed. This represents the first instance that such an effect was observed in the case of the (p,p′) reaction on ^{20}Ne. From the angular correlation of the ^{20}Ne(p,pγ) reaction, the role of the direct interaction mechanism in the appearance of the compensation effect was indicated. The coupling of elastic and pre-elastic channels was demonstrated on the basis of the angular distribution of the polarization of protons scattered by ^{24}Mg. The direct mechanism involving 8.5-MeV protons in the second excited state of ^{20}Ne was theoretically predicted and was experimentally demonstrated. Studies were also carried out on the angular correlation and distribution of (p,p′γ) on ^{26}Mg and on the apparent changes of the nuclear temperature with the energy of the bombarding particles in (α,n) reactions involving ^{55}Mn and ^{56}Fe. The decay scheme of the 159-μsec isomer of ^{115}Sn from the reaction ^{115}In(p,n) was studied as was isomeric ^{115}In. During the study of the spontaneous fission of the transuranic nuclides, the lifetime of ^{242m}Am was determined more accurately than before. (TTT)

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Refer also to abstracts 21858, 21963, 22101, 23238, 23414, 23441, 23442, 23456, 23471, 23474, 23475, 23477, 23534, 23536, 23541, and 23556.

23478 (IS-1413) STUDY OF DELAYED NEUTRONS FROM SEPARATED ISOTOPES. Day, George M.; Tucker, Allen B. (Ames Lab., Iowa). Mar. 8, 1967. Contract W-7405-eng-82. 9p. (CONF-670501-2). Dep. mn. CFSTI $3,00 cy, $0,65 mn.

From International Conference on Research Reactor Utilization and Reactor Mathematics, Mexico City, Mex.

A technique of studying short-lived delayed neutron precursors is described in which the isotopes can be separated by mass as well as by half life. An electromagnetic isotope separator is used on-line to provide a continuous source of radioactive nuclei. (D.C.W.)

23479 (JINR-E7-3155) DIRECT REACTIONS INDUCED BY HEAVY IONS. Volkov, V. V. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Nuclear Reactions). 1967. 14p. (CONF-660906-47). Dep. mn.

From International Conference on Nuclear Physics, Gatlinburg, Tenn.

The experimental data on the study of direct reactions with the transfer of one, two, and three neutrons, a proton, and ^{4}He are given. The excitation functions, angular distributions, and energy spectra were measured for several elements. In the reactions ^{27}Al(^{12}C,^{13}N)^{26}Mg and ^{12}C(^{12}C,^{13}N)^{11}B, the diffractional structure was observed in the angular distributions. A sharp dependence of the cross section upon Z of the target nucleus due to polarization of the proton wave function in the Coulomb field of the target nucleus was found in the reaction (^{12}C,^{13}N). The angular distribution and energy spectrum in the reaction (^{15}N,^{17}N) with ^{90}Zr, ^{92}Zr, ^{94}Zr targets were studied with a view of finding the effect of the structure on the reaction parameters. The complicated character of the spectrum obtained in the reaction ^{27}Al(^{14}N,^{18}F) indicates the existence of two mechanisms in the ^{4}He transfer reaction. In the bombardment of ^{181}Ta and ^{159}Tb with ^{20}Ne and ^{22}Ne ions, data were obtained on the transfer-reaction "spectrum." (auth)

23480 (JINR-P6-3128) ISSLEDOVANIE IZLUCHENIYA ^{150}Tb, ^{149}Tb, ^{149}Gd, I ^{149}Eu. (Investigation of ^{150}Tb, ^{149}Tb, ^{149}Gd, and ^{149}Eu Radiation). Vil'skii, K.; Gromov, K. Ya.; Zhelev, Zh. T.; Kuznetsov, V. V.; Muziol, G.; Nil'sen, O. B.; Skilbrait, O. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Nuclear Problems). 1967. 38p. (In Russian). Dep. mn.

The γ spectra of ^{150}Tb, ^{149}Tb, ^{149}Gd, and ^{149}Eu were investigated by using Ge(Li) semiconductor detector. Conversion-electron and positron spectra of ^{149}Tb and ^{150}Tb were studied as well as γ-γ coincidence spectra arising from ^{150}Tb, ^{149}Tb, and ^{149}Gd decays. β^{+}-γ coincidence spectra from the decay of ^{149}Tb and ^{150}Tb were studied by means of the triple-coincidence method. The schemes of ^{150}Gd, ^{149}Gd, ^{149}Eu, and ^{149}Sm excited levels are suggested. (auth)

23481 (JINR-P7-3185) NOVYI NEITRONODEFITSITNYI IZOMER TSEZIYA. (A New Neutron-Deficient Isomer of Cesium). Aleksander, K.; Noibert, V.; Potter, Kh. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Nuclear Reactions). 1967. 14p. (In Russian). Dep. mn.

A previously unreported isomeric state with a gamma transition energy of 98 ± 10 keV and a half life of 0.5 ± 0.05 sec was found. The isomer was excited in the reactions ^{112}Cd(^{14}N,xn) and ^{115}In(^{12}C,xn). The mass number, following from excitation function measurements, is probably 122. The multipolarity, determined via conversion electron measurements, is M2. (auth)

23482 (LA-3643) KILOVOLT EUROPIUM CAPTURE CROSS SECTIONS. Barr, Donald W.; Devaney, Joseph J. (Los Alamos Scientific Lab., N. Mex.). Dec. 15, 1966. Contract W-7405-eng-36. 51p. Dep. mn. CFSTI $3,00 cy, $0,65 mn.

Estimates of the europium radiative capture cross sections for neutrons are given for ^{151}Eu, ^{152}Eu, ^{153}Eu, ^{154}Eu, and ^{155}Eu. These calculations utilize the slope of the total cross section, resonance parameters, known odd-even versus odd-odd behavior, and theory. They are compared with experimental values derived from the nuclear device "Cyclamen" and from direct measurement. (auth)

23483 (NP-16671) DETERMINATION OF CONVERSION COEFFICIENTS IN THE DECAY OF ^{133}Ba BY MEANS OF SEMICONDUCTOR COUNTERS. Bosch, H. E.; Szichman, E.; Baseggio, A.; Dolinkue, R. (Instituto de Investigacione Aeronautica y Espacial, Buenos Aires (Argentina)). Dec. 1966. 17p. Dep. mn.

The K-conversion coefficients corresponding to four transitions in ^{133}Cs were determined using the electron-gamma coincidence method. The gamma rays were detected with conventional scintillation counters. A special electron-gamma coincidence spectrometer was constructed by using, as the electron detector, a lithium-drifted semiconductor counter operated in a vacuum chamber at low temperature. An analysis of electron-conversion spectra was performed by studying the line shapes of standard single lines as a function of the energy. The following values were obtained: $\alpha_K(0.081) = 1.34 \pm 0.09$, $(K/LM = 5.4 \pm 0.5)$; $\alpha_K(0.277) = 0.054 \pm 0.010$, $(K/LM = 5.5 \pm 1.5)$; $\alpha_K(0.305) = 0.037 \pm 0.003$; and $\alpha_K(0.356) = 0.023 \pm 0.002$, $(K/LM = 5.0 \pm 0.5)$. As a by-product the conversion coefficient for the 0.376 MeV transition was determined by analysis of the singles electron and gamma spectra, its value being $\alpha_K(0.386) = 0.028 \pm 0.010$, $K/LM = 5 \pm 1$). (auth)

23484 STUDY OF HYPERFRAGMENTS. PART IV. MECHANISM FOR PRODUCTION OF HYPERFRAGMENTS. Burte, D. P.; Chaudhari, K. N.; Ganguli, S. N.; Rao, N. K.; Swami, M. S. (Tata Inst. of Fundamental Research, Bombay). Proc. Indian Acad. Sci., Sect. A, 64: 213-23(Oct. 1966).

Hyperfragments produced in interactions of high energy pions and protons with emulsion nuclei were investigated to deduce information on their mechanism of production. From these studies it is concluded that (a) long-range hyperfragments ($R \geq 20$ μm.) which are due to fragments with mass number $\lesssim 15$, are produced in the evaporation stage of the disintegrations of Ag and Br nuclei of emulsions, (b) short-range hyperfragments ($R \leq 10$ μm.) are mainly due to residues of the target nuclei and a small fraction

(≈10%) of them in the range $5 < R_{HF} \leq 15$ μm. are due to fission-type processes that occur in high energy interactions, and (c) the relative probability of sticking of A^+ to fragments with Z = 2 to that with $3 \leq Z \leq 6$ is roughly in the ratio 1:10. (auth)

23485 SCATTERING OF FAST ELECTRONS BY ORIENTED ^{165}Ho NUCLEI. Safrata, R. S.; McCarthy, J. S.; Little, W. A.; Yearian, M. R.; Hofstadter, R. (Stanford Univ., Calif.). Phys. Rev. Lett., 18: 667-70(Apr. 17, 1967).

Differential cross sections for the scattering of 200-MeV electrons by oriented ^{165}Ho nuclei were measured and were compared with theoretical predictions. The effect of alignment on the cross sections was studied in detail. The results show that experiments involving electron scattering from oriented nuclei are far more sensitive to small changes in the parameters describing the nuclear charge–density distribution than is the case with measurements on randomly oriented nuclei. (D.C.W.)

23486 DECAY OF ^{182}Ta. Mangal, P. C.; Sud, S. P.; Trehan, P. N. (Panjab Univ., Chandigarh, India). Curr. Sci. (India), 36: 224-5(May 5, 1967).

The level scheme of ^{182}W was investigated by measuring sum-peak coincidence spectra of ^{182}W in 4π geometry. Evidence for the existence of a 680-keV level was obtained, and a 1740-keV level, which decays by a 1410-229-100 keV triple cascade, was proposed. (D.C.W.)

23487 FISSION CROSS SECTIONS OF ^{241}Am AND ^{242m}Am. Seeger, P. A.; Hemmendinger, A.; Diven, B. C. (Los Alamos Scientific Lab., N. Mex.). Contract W-7405-eng-36). Nucl. Phys., A96: 605-16(1967). (LA-DC-7624).

The acquisition and analysis of neutron cross section data from an experiment using an underground nuclear detonation are discussed with specific reference to fission cross sections measured in the Petrel event in June 1965. Results are presented for ^{242}Am and ^{242m}Am over the energy range 20 eV to 1 MeV, measured simultaneously in a single experiment covering the entire energy range, with very low background. Considerable sub-threshold fission was observed for ^{241}Am. The fission cross section of the doubly odd nucleide ^{242m}Am is about twice that of ^{239}Pu over most of the neutron energy range, but only about 20% greater at 1 MeV. (auth)

23488 ANGULAR DISTRIBUTIONS OF FRAGMENTS FROM NEUTRON-INDUCED FISSION OF THORIUM. Lo Nigro, S.; Milone, C. (Univ., Catania, Italy). Nucl. Phys., A96: 617-23 (1967).

The angular distribution of fragments of neutron-induced fission of thorium were measured with nuclear emulsions loaded with thorium nitrate and exposed to monoenergetic neutron beams in the energy range $1.7 < E_n < 5.3$ MeV. From the measured angular distributions, the values of the parameter K_0^2 are deduced and dependence on the excitation energy compared with that of other even-mass target nuclei. (auth)

23489 STUDY OF THE DECAY OF THE NUCLEUS OF ^{187}W. Widemann, F.; Sebille, C. (CNRS, Orsay, France). Port. Phys., 4: 215-54(1966). (In French).

The scheme of the levels of ^{187}Re fed by the β decay of ^{187}W was investigated. Added to the two transitions of 746 and 880 keV which were found with Ge–Li γ spectrometers, an internal-conversion study with 180° magnetic spectrometers equipped with preacceleration shows a number of new transitions. Two transitions of 7.1 and 77.2 keV are tentatively placed on the level scheme. The multipolarities are given with precision through $L_I/L_{II}/L_{III}$ conversion ratios up to 380 keV, where intensity allows it. Uncertainties on certain spins are eliminated through branching ratios calculations. The nature of the 880-keV level is discussed. (auth)

23490 POSSIBLE DEFORMED STATES IN ^{115}In AND ^{117}In. Baecklin, A. (Uppsala Univ. Swedish Research Council Lab., Studsvik, Sweden); Fogelberg, B.; Malmskog, S. G. Nucl. Phys., A96: 539-60(1967).

Levels and transitions in ^{115}In and ^{117}In were studied from the beta decay of 2.3 d ^{115g}Cd and 2.5 h ^{117g}Cd. Using a Ge(Li) detector and a double focussing beta spectrometer, energies, intensities, conversion coefficients and multipolarities were obtained for the following transitions (energies in keV and multipolarities are given): ^{115}In: 35.63 (97.0% M1 + 3.0% E2), 231.47 (E1), 260.80 (M1), 267, 336.23 (M4 + <5% E5), 492.14 (96% E1 + 4% M2), 527.70 (E1); ^{117}In: 71.0, 89.80 (E2 + < 20% M1), 273.32 (M1, E2), 315.27 (M4 + <7% E2), 344.29 (E1), 434.12 (E1). Using the delayed coincidence technique, half-lives were measured for two levels in ^{115}In and for three levels in ^{117}In. Energies, spins, parities and half-lives are given for the following levels: ^{115}In: 597.03, $3/2^-$; 828.39, $3/2^+$, 5.4 ns; 863.95, $1/2^+$ or $3/2^+$, 1.1 ns. ^{117}In: 588.59, $3/2^-$; 0.20 ns; 659.56, $3/2^+$, 58.7 ns; 749.37, $1/2^+$ or $3/2^+$, 4.3 ns. Reduced transition probabilities are given for several transitions in both nuclei. The E2 transition rates between the two excited positive parity states in both nuclei were found to be about 100 s.p.u. indicating a possible deformation of these states. The energy spacing and transition rates between these states can be well accounted for within the Nilsson model assuming the states to form a $K = 1/2^+$ rotational band. A deformation δ of about 0.20 is obtained for both nuclei. (auth)

23491 ISOMERISM IN ^{176}Hf AND SOME NEIGHBORING EVEN NUCLEI. Borggreen, J.; Hansen, N. J. S.; Pedersen, J.; Westgaard, L.; Zylicz, J.; Bjoernholm, S. (Univ. of Copenhagen). Nucl. Phys., A96: 561-87(1967).

Isomeric states in some doubly even nuclei were investigated with the use of a pulsed beam technique. In ^{176}Hf a level at 1562 has a half-life of 10.3 μs and a level at 1335 keV has a half-life of 13.0 μs. In ^{174}Yb an isomeric state at 1520 keV with a half-life of 820 μs was studied. ^{176}Yb has an isomeric level with a half-life of 12 s at 1041 keV, and in ^{180}W an isomeric level with a half-life of 5.2 ms and an energy of 1530 keV above the ground state was studied. All the isomers are ascribed to two-quasiparticle states which decay to a lower lying rotational band by K-forbidden γ-transitions. The level at 1562 keV in ^{176}Hf is ascribed to the coupling of the two proton orbitals $7/2^+$[404] and $9/2^-$[514] to a spin and parity 8^-. The other isomer in ^{176}Hf, at 1335 keV, and the one in ^{174}Yb, are ascribed to the coupling of the neutron orbitals $5/2^-$[512] and $7/2^-$[514] to give $K^\pi = 6^+$. The two isomeric states in ^{176}Yb and ^{180}W are due to the coupling of the neutron orbitals $7/2^-$[514] and $9/2^+$[624] to a spin and parity 8^-. The branching ratios of the decays of the isomeric states are analyzed and compared with theoretical predictions. The energies of the two-quasiparticle states are compared with calculations of the energy gap based on the Nilsson model. Comparisons are also made with pairing energies calculated on the basis of empirical neutron and proton separation energies. (auth)

23492 PROBABILITY OF α-PARTICLE EMISSION DURING FISSION. Doan, Thu Phong; Carles, Claude; Chastel, Raymond (Univ., Bordeau). Nucl. Phys., A96: 588-92(1967).

The experimental results of Schmitt and Feather for thermal neutron fission of ^{235}U, are used to draw the curve of variation of intrinsic α-particle emission probability versus the mass ratio of fragments. Taking account that this curve is valuable in the mass range 233 to 241, the experimental rate of ternary α-particle production is found. A similar shape exists at scission in binary fission and light-particle ternary fission. The correlation between symmetrical fission and light-particle ternary fission is explained. (auth)

23493 STUDY OF THE SPINS OF THE LEVELS OF ^{215}Po BY AN ANGULAR CORRELATION METHOD. Letessier, J.; Bertault, D.; Cluzeau, S.; Petit, G. Y. (Univ., Bordeaux). Nucl. Phys., A96: 689-95(1967). (In French).

Angular correlations for transitions ^{219}Rn $\xrightarrow{\alpha}$ ^{215}Po*(272 keV) $\xrightarrow{\gamma}$ ^{215}Po and ^{219}Rn $\xrightarrow{\alpha}$ ^{215}Po*(401 keV) $\xrightarrow{\gamma}$ ^{215}Po were measured. Spins of $7/2$, $5/2$, and $3/2$ for the ground state and excited states of 272 and 401 keV of ^{215}Po, respectively are proposed. (auth)

23494 ANGULAR DISTRIBUTIONS FOR THE ^{160}Gd(d,t)^{159}Gd REACTION. Jaskola, M.; Nyboe, K.; Tjoem, P. O.; Elbek, B. (Univ. of Copenhagen). Nucl. Phys., A96: 52-64(1967).

The angular distributions for triton groups from the ^{160}Gd(d,t) reaction were measured at a deuteron energy of 12.1 MeV. The Nilsson assignments which were known for a considerable number of levels in ^{159}Gd made it possible to intercompare the distributions for selected groups with l = 0, 1, 2, 3, 4, 5, and 6. An optical-model triton potential was found which gave a good fit to the data at forward angles. Deviations at backward angles indicate that the cross sections depend on the total angular momentum j of the transferred neutron. (auth)

23495 THE LINEAR POLARIZATION OF THE 482-keV TRANSITION IN ^{181}Ta. Davies, K. E.; Hamilton, W. D. (Univ. of Sussex, Eng.). Nucl. Phys., A96: 65-80(1967).

The 482-keV E2-M1 transition in ^{181}Ta is important in nuclear penetration and parity violation experiments. A critical analysis of previous experiments indicates discrepancies and inconsistencies in the analysis of the experimental data for the determination of the mixing ratio for this transition. A new determination was made of the mixing ratio using a method which is independent of perturbing effects which were present in all previous determinations. This method depends on the comparison of results obtained from γ-γ directional and linear polarization correlation experiments, using the same source for both experiments. The method of analyzing this type of experiment is presented. The value δ = 7.2 is in agreement with the presently accepted value. (auth)

23496 LIFETIME MEASUREMENTS OF EXCITED STATES IN ^{115}In. Nainan, T. D.; Clausen, K. D.; Kahle, R. L. (Nebraska Wesleyan Univ., Lincoln). Nucl. Phys., A96: 173-6(1967).

The half lives of excited states of 829/864 keV in ^{115}In were measured using delayed coincidence techniques and were found to be 5.99 ± 0.03 and 1.15 ± 0.04 ns. A lower limit of 0.25 ns was set for the 597-keV state. (auth)

23497 ABSOLUTE MEASUREMENTS OF LONGITUDINAL β POLARIZATION IN ^{32}P DECAY. Wenninger, H.; Stiewe, J.; Muusz, H.; Leutz, H. (Univ., Heidelberg). Nucl. Phys., A96: 177-89(1967).

The longitudinal β polarization P was absolutely measured for five β energies in the ^{32}P spectrum. The β momenta were modified by electrostatic acceleration of the emitted β particles and were separated by a short magnetic lens with a relative momentum spread of 6%. Crossed electric and magnetic fields were used to rotate the β spin by 90° relative to the β direction, and the transverse β polarization was determined by the analysis of Mott scattering asymmetries. The results, $-P/(v/c) = 1.00 \pm 0.04$ (230 keV); 1.00 ± 0.04 (290 keV); 1.01 ± 0.03 (349 keV); 1.02 ± 0.03 (410 keV); 1.00 ± 0.03 (481 keV) give a mean value between 200 and 500 keV of 1.00 ± 0.01 and show that the longitudinal β-polarization coefficient equals unity for β particles in ^{32}P decay. (auth)

23498 THE DECAY OF ^{155}Tb(5.6 d) AND ^{155}Eu(1.81 y) TO LEVELS IN ^{155}Gd. Blichert-Toft, P. H.; Funk, E. G.; Mihelich, J. W. (Univ. of Notre Dame, Ind.). Nucl. Phys., A96: 190-208 (1967). (COO-498-57).

The electron-capture decay of ^{155}Tb(5.6 d) and the beta decay of ^{155}Eu(1.81 y) to excited states in ^{155}Gd were studied with a Ge(Li) detector and a scintillation spectrometer in singles and coincidence. The ^{155}Tb sources were obtained from the ^{153}Eu(α,2n)^{155}Tb and ^{154}Gd(α,3n)^{155}Dy reactions. Previously unreported transitions in the decay of ^{155}Tb with energies of 200.3, 235.1, 326.0, 383.1, 391.4, 427.4, 487.5, 532.4 and 647.8 keV were observed. The results including coincidence data permit an improvement of the level scheme of ^{155}Gd previously proposed on the basis of internal-conversion-electron data. Gamma transitions were incorporated into a consistent level scheme for ^{155}Gd with levels at 60.0, 86.5, 105.3, 118.0, 146.0, 235.1, 266.6, 268.6, 286.8, 326.0, 367.7, 427.3, 451.3, 488.8, 592.6 and 647.7 keV. Ratios of experimental gamma transition probabilities from the 488.8, 451.3, 326.0, 286.8, 118.0, 105.3 and 86.5 keV states are presented. An attempt was made to discuss the level scheme of ^{155}Gd in terms of the Nilsson model. (auth)

23499 INTERNAL CONVERSION OF E2 TRANSITIONS IN ^{152}Sm AND ^{154}Gd. Holmberg, L.; Stefansson, V.; Pettersson, B.-G. (Univ. of Stockholm). Nucl. Phys., A96: 33-41(1967).

In a recent investigation the K-conversion electron particle parameters for three E2 transitions in the deformed nuclei ^{152}Sm and ^{154}Gd were found to be anomalous; for the 245-keV transition in ^{152}Sm the reported deviation from the theoretical value was 39 ± 9%. A new measurement was carried out. For the transitions of 122 keV in ^{152}Sm and of 123 keV in ^{154}Gd the values found, expressed in units of finite-size corrected theoretical values, are $b_2(122)/b_2^0(122) = 0.99 \pm 0.04$, and $b_2(123)/b_2^0(123) = 0.99 \pm 0.03$. For the 245-keV transition, which is of low intensity, a fairly high accuracy in the value obtained for the particle parameter was made possible by use of the b_4 method. From the geometrical relation between b_2 and b_4, $b_2(245)/b_2^0(245) = 1.02 \pm 0.04$ was obtained. It is shown that if only dynamic contributions to the tabulated values are assumed, this result corresponds to a value for the conversion coefficient of $\alpha_K(245)/\alpha_K^0(245) = 1.01 \pm 0.015$. (auth)

23500 ELECTRON-GAMMA AND GAMMA-ELECTRON DIRECTIONAL CORRELATION EXPERIMENTS ON THE 496 keV-124 keV CASCADE IN ^{131}Cs. Sen, S. K.; Dohan, D. A. (Univ. of Manitoba, Winnipeg, Can.). Nucl. Phys., A96: 42-8 (1967).

Careful studies were made of the directional correlations between the 496-keV K-conversion electron and the 124-keV gamma ray and between the 496-keV gamma ray and the 124-keV K-conversion electron in the 620–124–0 keV cascade of ^{131}Cs formed by the electron capture decay of ^{131}Ba. The coefficients $A_{22} = -0.113 \pm 0.031$ and $A_{44} = +0.140 \pm 0.036$ obtained from the K electron-gamma angular correlation measurements and the coefficients $A_{22} = -0.012 \pm 0.012$ and $A_{44} = +0.014 \pm 0.014$ obtained from the gamma-K electron angular correlation measurements together with the previously measured mixing ratio for the 124-keV transition give the spin sequence $\frac{3}{2}^+(M1 + E2)\frac{5}{2}^+(E2 + M1)\frac{5}{2}^+$ for the cascade. The experiments were performed with a system, capable of electron resolution of 5-keV FWHM at 1.0 MeV, allowing the K conversion lines to be unambiguously separated from the L lines. Evidence is presented for the presence of electric monopole E0 electric transitions in direct competition with M1 and E2 internal conversion transitions from the 124-keV level. The experiments also confirm that the 496-keV transition is predominantly M1 but establishes that it has a 23 ± 7% E2 admixture. The new measurements together with previous measurements of the gamma-gamma angular correlation and the internal conversion coefficients give a more complete picture of the cascade. (auth)

23501 A STUDY OF THE LEVEL STRUCTURE OF ^{148}Sm EXCITED IN THE DECAY OF ^{148}Eu. Cline, J. E. (National Reactor Testing Station, Idaho Falls, Idaho). Nucl. Phys., A96: 97-114(1967).

The decay of ^{148}Eu(54d) to levels in ^{148}Sm was studied using the techniques of Si(Au), Si(Li), Ge(Li), and NaI(Tl) spectrometry. Sources were made by ^{149}Sm(p,2n)^{148}Eu reactions and were chemically purified using ion-exchange techniques. Over 120 transitions were identified as being associated with the decay of this nuclide and approximately 90 were placed in a decay scheme containing 30 energy levels. Multipolarity assignments to many of the stronger transitions were made on the basis of conversion coefficients measurements. (auth)

23502 PRECESSION MEASUREMENTS FOLLOWING COULOMB EXCITATION WITH OXYGEN IONS. IV. GYROMAGNETIC RATIOS AND INTERNAL FIELDS IN EVEN Nd ISOTOPES. Ben Zvi, I.; Gilad, P.; Goldring, G.; Herber, R.; Kalish, R. (Weizmann Inst. of Science, Rehovoth, Israel). Nucl. Phys., A96: 138-44(1967).

Precision measurements are reported for 2^+ states of ^{148}Nd, ^{146}Nd, and ^{144}Nd. The measurements for ^{148}Nd were carried out both in an external magnetic field and in internal magnetic fields inside ferromagnetic matrices. In this way, both the g-factor of the state in ^{148}Nd and the intensities of the internal fields were determined. All other precession measurements were carried out in iron and cobalt matrices. (auth)

23503 SOME NEW PROPERTIES OF ^{254}Es AND ^{255}Es. Fields, P. R.; Diamond, H.; Friedman, A. M.; Milsted, J.; Lerner, J. L.; Barnes, R. F.; Sjoblom, R. K.; Metta, D. N.; Horwitz, E. P. (Argonne National Lab., Ill.). Nucl. Phys., A96: 440-8(1967).

Alpha decay of the 39.3-hr ^{254m}Es isomer was observed, and further studies showed that this decay populates a 2^- excited state in ^{250}Bk, but decay to the 2^- ground state is highly hindered. The partial alpha half-life of ^{254m}Es is 1.52 ± 0.1 yr. A lower limit to the spontaneous fission half-life of ^{254}Es was set at 2.5×10^7 yr. The total decay and partial spontaneous fission half-lives of ^{254}Fm were redetermined to be 194.4 ± 0.1 min and 228 ± 1 d, respectively. The pile neutron cross sections of ^{253}Es to produce the two isomers of ^{254}Es were measured to be σ_c = 13 b (^{254}Es), σ_c = 338 b (^{254m}Es). The partial alpha half-life of ^{255}Es was measured and 1.38 ± 0.08 yr and the partial spontaneous fission half-life to be 2440 ± 140 yr. The rotational band structure observed in the alpha decay of ^{255}Es is consistent with a $\frac{7}{2}^+$ spin. (auth)

23504 DECAY OF ^{174m}Lu. Gizon, A.; Godart, J. (Faculte des Sciences, Grenoble, France). Nucl. Phys., A96: 401-9(1967). (In French).

The internal conversion electron spectrum of ^{174m}Lu is measured with an iron-free beta spectrometer. The half-life is estimated to be 157 ± 5 d. The E2 transition of 111.8 keV and the E4 transition of 126.2 keV are found. (auth)

23505 ANGULAR CORRELATION OF FISSION FRAGMENTS AND PROMPT γ-RAYS FROM SLOW NEUTRON FISSION OF ^{235}U. Skarsvag, K. (Kjeller Research Establishment, Norway). Nucl. Phys., A96: 385-96(1967).

The angular correlation of fission fragments and prompt γ rays in slow neutron fission of ^{235}U was measured for forward and backward angles for γ rays energies greater than 300 keV. The measurements were performed with a target on a thick backing and for two geometries — with the semiconductor detector and the NaI(Tl) scintillation detector on opposite sides of the backing and with the detectors on the same side of the backing. The analysis shows confirmation of the features observed in spontaneous fission of ^{252}Cf. (auth)

23506 SPECTROSCOPIC FACTORS FOR (d,p) REACTIONS ON THE ODD-MASS TIN ISOTOPES. Baranger, Elizabeth; Kuo, T. T. S. (Univ. of Pittsburgh). Nucl. Phys., A97: 289-97(1967).

Spectroscopic factors for (d,p) reactions on the odd-mass tin isotopes are calculated using wave functions computed in a previously reported shell-model calculation. In that calculation, an effective interaction of Gaussian form was used as the residual shell-model interaction, and the BCS–TDA approximation was made. The spectroscopic factors are compared with the experimental values of Schneid, Prakash and Cohen. Quite good agreement is obtained for the levels excited by l = 2; only qualitative agreement is obtained for levels excited by l = 0. (auth)

23507 ALPHA DECAY OF NEUTRON-DEFICIENT ASTATINE ISOTOPES. Treytl, William; Valli, Kalevi (Univ. of California,

Berkeley). Contract W-7405-eng-48. Nucl. Phys., A97: 405-16 (1967). (UCRL-17194).

Isotopes of astatine lighter than mass 205 were studied at the Heavy Ion Linear Accelerator by bombardment of ^{185}Re and ^{187}Re with ^{20}Ne, using Si (Au) surface-barrier detectors in on-line measurements. Mass number assignments of ^{201}At through ^{196}At are based on excitation functions and on genetic relations with polonium isotopes. Accurate alpha energies are reported for ^{204}At through ^{196}At, for ^{202}Po through ^{194}Po, and for four light bismuth isotopes. Half-lives are given for ^{202}At through ^{196}At, and for the bismuth isotopes. Isomerism was detected in ^{202}At, ^{200}At, and ^{198}At. (auth)

23508 THE CALCULATION OF NUCLEAR ROTATIONAL STATES BASED ON THE GENERALIZED HARTREE-FOCK APPROXIMATION. Sano, Mitsuo (Western Reserve Univ., Cleveland); Wakai, Masamichi. Nucl. Phys., A97: 298-320(1967).

The generalized Hartree-Fock method is applied to a description of rotating nuclei, and the generalized Hartree-Fock equation is solved with the aid of self-consistent perturbation calculations. Numerical calculations are carried out for the rare-earth nuclei, and the results are compared with experiment. It is shown that good agreement with experiment is obtained. (auth)

23509 EXCITATION ENERGY OF SPONTANEOUSLY FISSIONING ISOMER ^{242m}Am. Flerov, G. N. (Joint Inst. for Nuclear Research, Dubna, USSR); Pleve, A. A., Polikanov, S. M.; Tretyakova, S. P.; Martalogu, N.; Poenaru, D.; Sezon, M.; Vilcov, I.; Vilcov, N. Nucl. Phys., A97: 444-8(1967).

The excitation function for the reaction ^{243}Am(n,2n)^{242m}Am leading to the formation of a spontaneously fissioning isomer was studied. The mono-energetic 8 to 14.4 MeV neutrons were obtained from the reaction D(d,n)^{3}He using a gaseous deuterium target. The excitation function has a distinct threshold character. The neutron energy corresponding to the reaction threshold is found to be 9.2 ± 0.3 MeV cms. The difference between this value and the threshold of the reaction leading to the ground state, equal to 2.9 ± 0.4 MeV, is considered as the excitation energy of the spontaneously fissioning state of ^{242}Am. (auth)

23510 THE DECAY OF ^{105}Ru. Schriber, S. O.; Johns, M. W. (McMaster Univ., Hamilton, Ont.). Nucl. Phys., A96: 337-66 (1967).

The energies and intensities of 61 gamma rays following the decay of ^{105}Ru were measured, and the internal conversion coefficients of 18 transitions were determined. The end-points and intensities of the partial beta spectra feeding 13 levels were observed using magnetic spectrometers and coincidence techniques. The γ-γ coincidence probabilities using NaI(Tl) and Ge(Li) detectors were determined. The measurements support a level structure in ^{105}Rh which includes the following states: 0($\frac{1}{2}^+$), 129.7($\frac{1}{2}^-$), 149.2($\frac{3}{2}^+$), 392.6($\frac{3}{2}^-$), 455.9($\frac{3}{2}^-$), 469.4($\frac{5}{2}^+$), 499.2($\frac{5}{2}^-$, $\frac{5}{2}^+$), 638.7($\frac{1}{2}^+$), 724.5($\frac{5}{2}^+$), 762.0, 785.9($\frac{3}{2}^-$), 806.1($\frac{3}{2}^+$), 969.5($\frac{3}{2}^+$), 1215.2, 1269, 1321.3, 1345.2(+), 1377.1, 1442, 1486.6, 1697.5(+), and 1720.2(+) keV. The spin of ^{105}Ru appears to be $\frac{3}{2}^+$, and the beta decay energy is 1916 ± 4 keV. (auth)

23511 ISOMERIC STATES IN ^{187}Au AND ^{189}Au. Heiser, C.; Alexander, K. F.; Brinckmann, H. F.; Nenov, N.; Neubert, W.; Rotter, H. (Joint Inst. for Nuclear Research, Dubna, USSR. Zentralinstitut fuer Kernforschung, Rossendorf, Ger.). Nucl. Phys., A96: 327-36(1967). (In German).

By irradiation of Ta and Hf with ^{12}C and ^{14}N ions, two new activities with half lives of 4.7 ± 0.1 min and 142 ± 5 ms were found. From measurements of excitation functions and from exact determination of the x-ray energy by means of a germanium detector, it was found that the activities belong to isomeric states in ^{189}Au and probably in ^{187}Au. The isomeric state in ^{189}Au populates by K-capture decay a level in ^{189}Pt, which lies at least 166 keV above the ground state, whereas the isomeric state in ^{187}Au decays by an E3-M1 cascade to the ground state. (auth)

23512 HIGHLY-EXCITED ISOMERIC NUCLEAR STATE IN ^{132}Xe. Brinckmann, H. F.; Heiser, C.; Fromm, W. D. (Zentralinstitut fuer Kernforschung, Rossendorf, Ger.). Nucl. Phys., A96: 318-26(1967). (In German).

In the reaction ^{130}Te(α,2n)^{132}Xe an isomeric state with a half life of 8.4 ± 0.8 ms and the very high excitation energy of 2754 ± 3 keV was observed. From measurements of the delayed γ spectrum and γ-γ coincidence, it followed that the isomeric state decays by a cascade of five γ transitions having energies of 176 ± 1, 537 ± 1, 601 ± 1, 668 ± 1, and 772 ± 1 keV. The assignment to ^{132}Xe follows from the excitation function and the good agreement of the γ energies of 668 and 772 keV with well-known E2 transitions in ^{132}Xe. Several possibilities for the decay of ^{132m}Xe are discussed. The half life and some qualities of this isomer are in agreement with those measured by Demin and Kushakewich in (Te + α) reactions. But their assignment to ^{126}Xe is in disagreement with the present results. (auth)

23513 DYNAMIC EFFECTS IN THE INTERNAL CONVERSION OF E1 TRANSITIONS IN ^{175}Lu. Holmberg, L.; Gidefeldt, L.; Gunnerhed, M.; Pettersson, B.-G. (Univ. of Stockholm). Nucl. Phys., A96: 305-17(1967).

The directional correlations of the (283K-114γ), (145K-251γ), (283γ-114K), and (283γ-114γ) cascades in ^{175}Lu were studied. The K-conversion electron particle parameters were determined for the retarded electric dipole transitions of 283 and 145 keV. Penetration parameters were derived from these measurements, by use of experimental K-conversion coefficient values for the mixing ratios δ(M2/E1) obtained from a nuclear alignment experiment by Grace et al. Contrary to what has been suggested by earlier experiments, no evidence was found for dynamic effects in the mixed M1 + E2 114-keV transition. (auth)

23514 GAMMA RADIATION OF ^{131}I. Ythier, Christian; Ardisson, Gerard (Faculte des Sciences, Nice). Compt. Rend., Ser. C, 264: 944-6(Mar. 13, 1967). (In French).

The gamma radiation of iodine-131 was studied, after chemical separation, with the aid of a spectrometer using an n-i-p germanium diode as the detector. The decay scheme must be modified to take account of the result of coincidence measurements and of the observation of many new gammas, especially at 272.2, 317.8, and 405.7 keV. (tr-auth)

23515 HALF-LIFE MEASUREMENTS IN ^{155}Gd. Malmskog, G. (Aktiebolaget Atomenergi, Stockholm). Ark. Fys., 33: 291-5(1967).

In the literature there exists a definite difference for the half life of the 86.5-keV level in ^{155}Gd depending on whether ^{155}Eu or ^{155}Tb sources have been used. Using a good energy resolution electron-electron coincidence spectrometer and a Eu-155 source, a half life of 6.48 ± 0.26 nsec was obtained for the 86.5-keV level. This is in agreement with the values previously measured with ^{155}Tb sources. The half life of the 105.4-keV level was measured to be 1.12 ± 0.05 nsec. (auth)

23516 THE ^{199}Hg(n,γ)^{200}Hg REACTION WITH THERMAL NEUTRONS. Bartholomew, G. A.; Naqvi, S. I. H.; Gunye, M. R.; Earle, E. D. (Atomic Energy of Canada Ltd., Chalk River, Ont.). Can. J. Phys., 45: 1517-40(Apr. 1967). (AECL-2866).

Thermal neutron-capture γ rays from ^{199}Hg(n,γ)^{200}Hg were studied with a lithium germanium detector and with angular correlation techniques. Gamma-ray and level energies were determined with accuracies of at best ±3 keV. Spin 0 for the capturing state was confirmed, and levels at 1,569, 2,060, 2,369, 2,640, 3,186, 3,269, 3,289, 3,351 keV were assigned spin 1. The ^{200}Hg level scheme is discussed. (auth)

23517 THE g FACTOR OF THE 633-keV LEVEL IN ^{186}Os. Murray, J.; McMath, T. A.; Cameron, J. A. (McMaster Univ., Hamilton, Ont.). Can. J. Phys., 45: 1597-1600(Apr. 1967).

The g-factor of the 633-keV gamma-vibrational level of ^{186}Os was measured to be +0.43 ± 0.08 using the method of perturbed angular correlations. (D.C.W.)

23518 THE g FACTOR OF THE 603-keV LEVEL IN ^{124}Te. Murray, J.; McMath, T. A.; Brooker, W. H.; Cameron, J. A. (McMaster Univ., Hamilton, Ont.). Can. J. Phys., 45: 1600-4 (Apr. 1967).

The g-factor of the 603-keV level of ^{124}Te was measured to be +0.39 ± 0.09 using the method of perturbed angular correlations. (D.C.W.)

23519 ISOMERIC CROSS SECTIONS AND YIELD RATIOS OF (d,p) REACTIONS BELOW 15 MeV. Natowitz, J. B.; Wolke, R. L. (Univ. of Pittsburgh). Phys. Rev., 155: 1352-61(Mar. 20, 1967).

Absolute cross sections and isomeric yield ratios of (d,p) reactions in ^{59}Co, ^{89}Y, ^{103}Rh, ^{110}Pd, ^{114}Cd, ^{133}Cs, ^{181}Ta, ^{187}Re, and ^{196}Pt were determined between ~4 and ~15 MeV. The isomer ratios are found to increase gradually with bombarding energy from values at lower energies which are only slightly greater than the ratios for the production of the same isomeric pairs by the (n,γ) reaction. The qualitative features of (d,p) isomer ratios are discussed. Isomer ratios have been calculated at 15 MeV for seven (d,p) reactions in even-even targets by using distorted-wave Born approximation to obtain the initial angular momentum distributions and computing the effects of subsequent gamma-ray cascades leading to the observed isomeric states. Agreement with experiment of the order of 15 to 20% is achieved. The effects of various cascade treatments on the agreement of the calculated isomer ratios with experiment are discussed. (auth)

23520 PARAMETERS OF NEUTRON RESONANCES IN ^{232}Th. Bhat, M. R.; Chrien, R. E. (Brookhaven National Lab., Upton, N. Y.). Phys. Rev., 155: 1362-8(Mar. 20, 1967). (BNL-10639).

The neutron widths and radiation widths of the four lowest S-

wave resonances in thorium, E_0 = 21.7, 23.4, 59.4, and 69.1 eV, were measured using transmission techniques. A mean value of Γ_γ of 20.1 ± 1.3 MeV is obtained for these four measurements. Using these parameters, the resonance capture integral for thorium is computed and found to be 86 ± 6 b, in substantial agreement with recent measurements. No evidence is found for a fluctuating component of Γ_γ within the experimental error. The methods of analysis, including the use of a non-Gaussian resolution function, are described. (auth)

23521 NEUTRON-CAPTURE GAMMA-RAY STUDIES IN ISOTOPES OF TUNGSTEN. Spencer, Robert R.; Faler, Kenneth T. (Idaho Nuclear Corp., Idaho Falls). Phys. Rev., 155: 1368-76(Mar. 20, 1967).

Gamma-ray spectra from a natural-W target following the capture of 0.06-eV neutrons and neutrons corresponding in energy to the lowest-energy resonances in ^{182}W, ^{183}W, and ^{186}W were obtained at high resolution using a Li-drifted Ge detector. Transitions were identified which take place from the capture states to states near ground states in the final nuclei. Low-lying states previously known were observed and several new states were identified. Precise energy values and approximate relative intensities of the transitions are given. (auth)

23522 ISOBARIC ANALOGUE STATES IN HEAVY NUCLEI. IV. SAMARIUM ISOTOPES. Jolly, R. K.; Moore, C. F. (Florida State Univ., Tallahassee). Phys. Rev., 155: 1377-82(Mar. 20, 1967).

Isobaric analog resonances in the target-nucleus-plus-proton system were studied for the target nuclei ^{144}Sm, ^{148}Sm, ^{150}Sm, ^{152}Sm, and ^{154}Sm. All resonances were observed via elastic proton scattering, while some resonances for the target nuclei ^{144}Sm and ^{148}Sm were also observed via (p,n) reactions. The low-lying resonances have been analyzed using a single-resonance formula yielding the various resonance parameters. Results are compared with (d,p) and other studies on the neutron-plus-target analog states. Coulomb displacement energies are presented. (auth)

23523 PROTON SCATTERING FROM EVEN SAMARIUM ISOTOPES. Stoler, P.; Slagowitz, M.; Makofske, W.; Kruse, T. (Rutgers-The State Univ., New Brunswick, N. J.). Phys. Rev., 155: 1334-8(Mar. 20, 1967).

Differential cross sections were measured for 16-MeV protons elastically and inelastically scattered from even Sm isotopes. The behavior of the angular distributions exhibits marked change as the transition from the spherical vibrational nuclei to the deformed rotational nuclei is made. Results compare well with predictions of coupled channel calculations. (auth)

23524 HYPERFINE INTERACTION AND ISOMERIC SHIFT IN ^{195}Pt. Agresti, D.; Kankeleit, E.; Persson, B. (California Inst. of Tech., Pasadena). Contract AT(04-3)-63. Phys. Rev., 155: 1339-41(Mar. 20, 1967).

Using the Mössbauer technique the first-excited-state g factor for ^{195}Pt has been determined to be −0.41 ± 0.03. The following magnetic fields at the Pt nucleus were found: in an Fe lattice, 1.19 ± 0.04 MG; in a Co lattice, 0.86 ± 0.03 MG; and in a Ni lattice, 0.36 ± 0.04 MG. Isomeric shifts have been detected in a number of compounds and alloys and have been interpreted to imply that the mean square radius for the ^{195}Pt nucleus in the first excited state is smaller than in the ground state. (auth)

23525 HYPERFINE INTERACTIONS AND LIFETIMES OF LOW-ENERGY STATES IN ^{182}W AND ^{183}W. Agresti, D.; Kankeleit, E.; Persson, R. (California Inst. of Tech., Pasadena). Contract AT (04-3)-63. Phys. Rev., 155: 1342-51(Mar. 20, 1967).

The Mössbauer technique was used to study the nuclear hyperfine interactions and lifetimes in ^{182}W(2$^+$ state) and ^{183}W($\frac{5}{2}^-$ and $\frac{1}{2}^-$ states) with the following results: $g(\frac{5}{2}^-)/g(2^+) = 1.40 \pm 0.04$; $g(\frac{1}{2}^-) = -0.07 \pm 0.07$; $Q(\frac{5}{2}^-)/Q2^+) = 0.94 \pm 0.04$; $T_k(\frac{5}{2}^-) = 0.184 \pm 0.005$ nsec; $T_k(\frac{1}{2}^-) \gtrsim 0.7$ nsec. These quantities are discussed in terms of a rotation-particle interaction in ^{183}W due to Coriolis coupling. From the measured quantities and additional information on γ-ray transition intensities, magnetic single-particle matrix elements are derived. It is inferred from these that the two effective g factors, resulting from the Nilsson-model calculation of the single-particle matrix elements for the spin operators s_z and s_+, are not equal, consistent with the proposal of Bochnacki and Ogaza. The internal magnetic fields at the tungsten nucleus were determined for substitutional solid solutions of tungsten in iron, cobalt, and nickel. With $g(2^+) = 0.24$ the results are: H_{eff}(W-Fe) = −715 ± 10 kG; $|H_{eff}$(W-Co)| = 360 ± 10 kG; $|H_{eff}$(W-Ni)| = 90 ± 25 kG. The electric field gradients at the tungsten nucleus were determined for WS_2 and WO_3. With $Q(2^+) = -1.81$ b the results are: for WS_2, eq = −(1.86 ± 0.05) × 10^{18} V/cm^2; for WO_3, eq = (1.54 ± 0.04) × 10^{18} V/cm^2 and η = 0.63 ± 0.02. (auth)

23526 DECAY OF ^{115m}In. Murri, E. L.; McIsaac, L. D.; Helmer, R. G. (Idaho Nuclear Corp., Idaho Falls). Phys. Rev., 155: 1263-4(Mar. 20, 1967).

In addition to the previously reported isomeric transition (336.25 ± 0.10 keV), a gamma-ray transition of (497.3 ± 0.5) keV is observed in the decay of ^{115m}In. From previous information, it is inferred that the latter transition represents an 0.06% beta-decay branch to the first excited state in ^{115}Sn. The presence of this beta transition is consistent with the spin assignment of $\frac{3}{2}^+$ for this level. (auth)

23527 ENERGY LEVELS OF ^{166}Ho. Motz, H. T. (Los Alamos Scientific Lab., N. Mex.); Jurney, E. T.; Schult, O. W. B.; (and others). Phys. Rev., 155: 1265-98(Mar. 20, 1967). (LA-DC-6094).

The high-energy γ-ray spectrum from thermal-neutron capture in natural holmium was studied over the energy range of 5000 to 6200 keV. Low-energy gamma radiation of the same reaction was measured from 30 to 750 keV and conversion electrons from 29 to 500 keV. Data from the reaction ^{165}Ho(d,p)^{166}Ho were analyzed. The combination of the results of these experiments yields an energy of 6243 ± 3 keV for the neutron binding in ^{166}Ho. The ground-state rotational band is observed with members up to I = 6−, and the I = 7− level is strongly suggested. A K = 3+ band built on the 190.9-keV isomer, and a K = 4+ band are disclosed. The K = 3+ [523↑− 521↓] band members are observed up to I = 6+ and very probably I = 7+. The K = 4+ [523↑+ 521↓] band contains the 4+ and 5+ levels, and the 6+ is indicated. The 1+ [523↑− 523↓] level is strongly populated in the γ-ray cascade following neutron capture. A rotational band superimposed on this state and containing the 2+, 3+, 4+, 5+, and probably 6+ levels is proposed. The heads of the 5+ [523↑+ 521↑] and 2+ [523↑− 521↑] bands are suggested at 264 and 430-keV, respectively. The 7− and 8− members of the [523↑+ 633↑] band are indicated at 5 ± 2 and 136 ± 2 keV, respectively. The 6+ [523↑+ 512↑] state at 294 ± 2 keV probably decays through the 289.12-keV γ transition to the 5-keV level. An additional level with spin 4+ or 5+ was found at 558.56 keV. A 0 − (1−) state at 373.13 keV seems to be very weakly excited during the β decay of ^{166}Dy, but fairly strongly populated in the (n,γ) process. The precise energies of low-energy (n,γ) transitions permit a very accurate energy determination of most states observed or indicated. It is found that most bands where more than two members have been seen obey the simple rotational formula very accurately, i.e., they have a small value of B, the "rotation-vibration interaction constant." In fact, the rotation of ^{166}Ho is observed to be more perfect than that of neighboring even-even nuclei in the ground-state configuration. The γ-ray transition probabilities for intraband transitions obey the normal Alaga rules, and the constancy of the strength parameter, C^2/q^2, gives additional evidence for band assignments. A calculation of the energies of low-lying levels in ^{166}Ho shows good agreement with the observed level energies. The partial cross section for thermal-neutron excitation of the 1200-year state of ^{166}Ho has been found to be 3.5 ± 0.5 b by a measurement of the ratio of 1200-year to 27.74-h activities. (auth)

23528 ALPHA REDUCED WIDTHS OF EVEN-MASS POLONIUM NUCLEI. Chang, F. C. (St. John's Univ., Jamaica, N. Y.). Phys. Rev., 155: 1299-1300(Mar. 20, 1967).

An attempt is made to obtain the alpha decay rates of even-mass Po nuclei as a product of two factors: (a) the probability of occurrence of an alpha cluster in a surface well, and (b) the decay rate when an alpha cluster is already formed there. From a comparison with the empirical values, it seems that this method for calculating the decay rates is valid. It is shown that the break in alpha reduced width on going from ^{210}Po to ^{212}Po can be interpreted as due to a break in the well width. It is suggested that the nuclear surface of ^{206}Pb is considerably more diffuse than that of doubly magic ^{208}Pb. It is also pointed out that our method gives a larger probability of finding an alpha cluster for ^{210}Po than for ^{212}Po, whereas the Mang theory leads to the opposite result—a larger probability for ^{212}Po. (auth)

23529 GAMMA-RAY SPECTRA FROM RADIATIVE CAPTURE OF THERMAL AND RESONANCE NEUTRONS IN MERCURY AND TUNGSTEN. Rae, E. R.; Moyer, W. R.; Fullwood, R. R.; Andrews, J. L. (Rensselaer Polytechnic Inst., Troy, N. Y.). Contract AT (30-3)-328. Phys. Rev., 155: 1301-8(Mar. 20, 1967). (RPI-328-69).

A 20-cc Li-drifted Ge detector has been used in conjunction with the R.P.I. Electron Linac Neutron Velocity Selector to examine the high-energy gamma-ray spectra arising from thermal and resonance neutron capture in Hg, and from resonance capture W. The effective gamma-ray energy resolution of 12 to 18 keV allowed 29 transitions to be examined in the energy range 4.67 to 8.02 MeV following capture of thermal neutrons and resonance neutrons of energy 34, 130, and 175 eV in ^{199}Hg (116 transitions in all). The spectra are interpreted in terms of levels in the compound nucleus ^{200}Hg. An analysis of the strengths of 88 E1 transitions indicates a Porter-Thomas distribution, the best fit being achieved

with a χ^2 function with $0.96^{+0.03}_{-0.04}$ degrees of freedom. The mean reduced partial radiation width for transitions to states in ^{200}Hg above the pairing energy gap is shown to be significantly higher than the corresponding mean width for transitions to collective states below the pairing energy. No such effect is obvious in the case of resonance capture in ^{183}W. A comparison between resonance capture in ^{198}Hg and ^{182}W, where no pairing energy gap exists, shows that the mean partial radiation width is a factor 4 larger for ^{198}Hg than for the highly distorted ^{182}W. (auth)

23530 SPONTANEOUS FISSION HALF-LIFE OF ^{242m}Am Caldwell, J. T.; Fultz, S. C.; Bowman, C. D.; Hoff, R. W. (Univ. of California, Livermore). Phys. Rev., 155: 1309-13(Mar. 20, 1967). (UCRL-70062).

The spontaneous-fission half life for the odd-odd nucleus ^{242m}Am was measured by a prompt-neutron fission-fragment coincidence method to be $(9.5 \pm 3.5) \times 10^{11}$ years. A correlation of experimental spontaneous-fission half-life data for nuclei of all classes was found to be $\log_{10}\tau - (\beta - Z^2/A)\delta M = -9.268(Z^2/A) + 374.0$, where β takes the values 42.22, 40.67, and 40.40 for even-even, odd-A, and odd-odd nuclides, respectively, τ is the spontaneous-fission half-life in years, and δM is the mass difference in milli-mass-units (mmu) between the values obtained from Green's smoothly varying mass formula and the experimentally measured values. (auth)

23531 NUCLEAR STRUCTURE STUDIES OF THE 83-NEUTRON SPECIES ^{143}Nd. Nealy, Carson L.; Sheline, Raymond K. (Florida State Univ., Tallahassee). Phys. Rev., 155: 1314-18(Mar. 20, 1967).

Thirty-eight states have been observed in ^{143}Nd between the ground state and 3576 keV utilizing 10-MeV deuterons and the reaction ^{142}Nd(d,p)^{143}Nd. The ground-state Q value for this reaction was measured as 3902 ± 15 keV. Absolute cross sections of the proton groups were measured. Angular distributions of most of the protons populating the lower-lying states were obtained and the corresponding l values determined. Shell-model assignments of the states were attempted and the spectroscopic factors calculated. The centers of gravity of the fragmented shell-model states were then compared with those of other 83-neutron species and with theory. (auth)

23532 VIBRATIONAL SPECTRUM OF ^{112}Cd. Barnes, P. D.; Comfort, J. R.; Bockelman, C. K. (Yale Univ., New Haven). Contract AT(30-1)-3223. Phys. Rev., 155: 1319-30(Mar. 20, 1967).

The energies and angular distributions of proton groups produced in the ^{111}Cd(d,p)^{112}Cd reaction were measured with an overall resolution of 20 keV. A distorted-wave analysis, employing experimentally determined optical-model parameters, was used to extract values of l_n and spectroscopic strengths for states up to 3.3-MeV excitation in ^{112}Cd. Wave functions of ^{111}Cd and ^{112}Cd calculated in the random-phase approximation are tested both by comparison of sum-rule predictions with the summed spectroscopic factors, and by comparison of individual spectroscopic factors with those predicted by the microscopic theory of nuclear vibrations for states in ^{111}Cd and the zero-, one-, and two-phonon states in ^{112}Cd. (auth)

Nuclear Theory

Refer also to abstracts 23257, 23409, 23410, 23412, 23413, 23415, 23417, 23422, 23425, 23442, 23446, 23457, 23464, 23506, 23508, and 23528.

23533 (AERE-R-6408) SCATTERING LAW $S(\alpha,\beta)$-VALUES FOR HEAVY WATER AT 540°K. Page, D. I. (Atomic Energy Research Establishment, Harwell (England)). Feb. 1967. 26p. Dep. mn. CFSTI $3.00 cy, $0.65 mn. HMSO 3s. 6d.

The differential scattering cross sections of D_2O at 540°K were measured for neutrons of 0.055 and 0.107 eV incident energy. The results are given as tables of scattering law $S(\alpha,\beta)$ values derived directly from the experimental data. The values cover ranges of energy and momentum transfers of 0 to 0.19 eV and 1 to 18 $Å^{-1}$, respectively. (UK)

23534 (ANL-7246) PHYSICS DIVISION SUMMARY REPORT. Annual Review, April 1, 1965-March 31, 1966. (Argonne National Lab., Ill.). Contract W-31-109-eng-38. 180p. Dep. mn. CFSTI $3.00 cy, $0.65 mn.

23535 (ISS-66/44) AN ANALYSIS OF QUASI-FREE ELECTRON SCATTERING ON NUCLEI AND CALCULATION OF THE ENERGY SPECTRA AND ANGULAR CORRELATIONS OF THE ^{12}C(e,e'p)^{11}B REACTION USING THE DISTORTED-WAVE IMPULSE APPROXIMATION. Ciofi degli Atti, C. (Istituto Superiore di Sanita, Rome (Italy). Laboratori di Fisica). Nov. 15, 1966. 43p. Dep. mn.

An analysis of quasi-free electron scattering on nuclei is given, and preliminary calculations of the energy spectrum and the angular correlations of the ^{12}C(e,e'p)^{11}B reaction, using the distorted-wave impulse approximation, are presented. In the framework of the shell model with intermediate coupling and using harmonic oscillator wave-functions, the experimental energy spectrum is fitted by varying the wave-function parameters. The oscillator parameters for the ls and lp states are then determined. Due to the lack of experimental data on angular correlations, the above analysis does not allow one to draw quantitative conclusions, although it gives a qualitative indication that the best-fit oscillator parameters must be different from those obtained by fitting the experimental angular correlations of (p,2p) reactions not taking distortion effects into account. (auth)

23536 (JAERI-1126) PROCEEDINGS OF THE 2ND SEMINAR ON FAST-NEUTRON CROSS SECTIONS [HELD IN TOKYO, 18-20 AUGUST 1966]. (Japan Atomic Energy Research Inst., Tokyo). Aug. 1966. 116p. (In Japanese). (CONF-660828). Dep. mn.

The 2nd Seminar on Fast-Neutron Cross Sections was held at the Tokai Research Establishment of the Japan Atomic Energy Research Institute on 18-20 August, 1966. About 70 scientists in the fields of the nuclear and reactor physics participated. The main topics were optical-model analyses, resonance analyses, and problems on fission cross sections. Some original papers presented at this Seminar, in addition to review papers on the above topics, are contained in this Proceedings. (auth)

23537 (JINR-P4-3124) IZUCHENIE TOCHNOSTI PRIBLIZHENNYKH METODOV SVERKHTEKUCHEI MODELI YADRA. (Investigation of the Accuracy of Approximate Methods in Superfluid Nuclear Model). Boshan, P.; Pavlikovski, A.; Rybarska, V. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Theoretical Physics). 1967. 14p. (In Russian). Dep. mn.

A model was considered: the interaction of six particles with the

$$-G\sum_{m'} a^+_{s_+} a^+_{s_-} a_{s'_-} a_{s'_+} - \frac{\kappa}{2} \sum_{ss'vv'\sigma\rho} f_{sv} f_{v'v'} a^+_{s\sigma} a_{s'\sigma} a^+_{v'\rho} a_{v\rho}$$

potential which are located on five two-fold degenerate equidistant levels. The influence of a multipole-multipole term was investigated by varying the κ and $f_{m'}$ parameters. The energy eigenvalues are exactly found in the framework of this simple model. The results are compared with approximate values obtained under the u-v transformation and by the method of approximate second quantization. (auth)

23538 (LA-3478(Pt.2)) TIME-OF-FLIGHT NEUTRON CROSS SECTION MEASUREMENTS USING NUCLEAR EXPLOSIONS. PART II. Seeger, P. A.; Bergen, D. W. (Los Alamos Scientific Lab., N. Mex.). Dec. 20, 1966. Contract W-7405-eng-36. 39p. Dep. mn. CFSTI $3.00 cy, $0.65 mn.

The procedures used for converting analog (film) records of data obtained from the interaction of nuclear-device-produced neutrons with target nuclei to cross sections as a function of neutron energy are described. A discussion of the errors is also presented. The conversion procedures include digitizing the records; converting all data to signal, S(t), vs time; deriving a background to be subtracted from all signals; deriving a flux based on the known cross section of a foil isotope; and obtaining the cross section by converting signal to reaction rate and dividing by the flux and foil density. (auth)

23539 (MIT-2098-217) PEREY EFFECT IN THE DEUTERON. Reading, John F. (Massachusetts Inst. of Tech., Cambridge). Jan. 12, 1966. Contract AT(30-1)-2098. 7p. Dep. mn. CFSTI $3.00 cy, $0.65 mn.

The Perey effect is investigated in the nucleon-nucleon case as a means for distinguishing between local and nonlocal interactions in the deuteron. In particular, it is believed that if the effect were small, it would provide a confirmation of the dominance of the deuteron pole. The effect is investigated using a nonlocal Hermitian potential and a local potential arising from the exchange of mesons. (S.F.L.)

23540 (MIT-2098-302) EFFECT OF EXCHANGE AND THE PAULI PRINCIPLE ON NUCLEON-NUCLEUS SCATTERING. [PART] I. Friedman, William A.; Feshbach, Herman (Massachusetts Inst. of Tech., Cambridge). Mar. 1967. Contract AT(30-1)-2098. 23p. Dep. mn. CFSTI $3.00 cy, $0.65 mn.

A method for the explicit treatment of identical-particle effects in the case of the N-coupled-channel problem is discussed, together with the problems that are raised by anti-symmetrization and exchange scattering. The formulation of the N-coupled-channel problem to eliminate these difficulties is also discussed. (D.C.W.)

23541 (NAA-SR-Memo-12314) EVALUATION OF HEAVY EVEN-EVEN NUCLIDE ELASTIC AND INELASTIC CROSS SEC-

TIONS BY MEANS OF A NONSPHERICAL OPTICAL MODEL. Dunford, Charles L. (Atomics International, Canoga Park, Calif.). Mar. 15, 1967. Contract AT(04-3)-701. 23p. Dep. mn, CFSTI $3.00 cy, $0.65 mn.

The heavy even-even isotopes were investigated with a combined nonspherical potential optical model and compound-nucleus theory. Compound-nucleus theory provides a method for treating all the reaction cross sections [fission, capture, (n,n'), (n,2n)]. An analysis of ^{238}U and ^{232}Th for which considerable data is available has justified the usefulness of this approach to evaluation. The nonspherical optical model permits the evaluator to separate the elastic and inelastic components of a measured angular distribution for these isotopes. Combined with an appropriate compound-nucleus model, it is possible to differentiate between conflicting sets of ^{238}U capture data within the range of 10 to 100 keV. (auth)

23542 (NP-16596) PARITAET UND RESTWECHSELWIRKUNG IN KOLLEKTIVEN NIVEAUX SPHAERISCH SYMMETRISCHER KERNE. (Parity and Residual Effects in Collective Levels of Spherically Symmetric Nuclei). Goetz, Ulrich (Basel Univ. (Switzerland)). [1966]. 35p. (In German). Dep. mn.

The interpretation of the lower energy levels of spherically symmetric nuclei as collective states gives for the parity the rule $(-1)^{\pi} = (-1)^{J}$. How far this parity rule can be established from the assumptions of the shell model and two-nucleon residual interaction was investigated. It was shown that a rigid derivation in the case of a Δ residual interaction, under consideration of a spin-spin coupling, is possible, but that in a general central potential in the Hamilton operator terms also occur violate the rule. The relative magnitude of such terms in dependence on the direction of the interaction should be estimated on the basis of a Gaussian potential. (tr-auth)

23543 (TID-22410) USE OF A GENERAL PURPOSE COMPUTER AS A NUCLEAR EVENT ANALYZER. Abel, L.; Fullwood, R. R. (Rensselaer Polytechnic Inst., Troy, N. Y. Dept. of Nuclear Engineering and Science); Jones, J. A. (Digital Equipment Corp., Maynard, Mass.). [1965]. Contract AT(30-3)-328. 16p. Dep. mn, CFSTI $3.00 cy, $0.65 mn.

As the cost/performance ratio of general-purpose computers has improved, their use in place of conventional wired program analyzers has become more and more desirable. Various methods of transferring information from a nuclear front end of a computer are described. An evaluation of these techniques is made and is compared with operating experience of the RPI on-line system. Other major advantages of an on-line computer are examined. These include generally faster cycle times (with consequently lower deadtimes), availability of complete prepackaged systems (with software included), and ease of interfacing to other devices and systems. (auth)

23544 THEORY OF NUCLEAR MATTER WITH NEUTRON EXCESS. Hassan, M. Y. M. (Inst. for Nuclear Research, Warsaw). Acta Phys. Pol., 31: 671-80(Apr. 1967).

A simple method of computing the symmetry energy is presented. In this method the hard-core part of nuclear forces is treated exactly (as an expansion in powers of $k_F r_C$, $\hbar k_F$ = Fermi momentum, r_C = hard-core radius, until second order terms in $k_F r_C$); and the attractive part is treated as a perturbation. The symmetry energy obtained is 67.5 MeV, which is comparable with the value usually quoted in the semi-empirical mass formula. (auth)

23545 VARIATIONAL CALCULATIONS IN LIGHT NUCLEI WITH REALISTIC NUCLEON-NUCLEON INTERACTIONS: GROUND-STATE DEFORMATIONS. Lande, Alexander (Princeton Univ., N. J. Univ. of Copenhagen). Phys. Rev. Lett., 18: 496-8(Mar. 27, 1967).

The results of variational calculations for the ground-state deformation of even-even nuclei, $8 \leq A \leq 36$, are presented. It is found that the potential energy depends weakly on deformation when compared with the corresponding variations in the kinetic energy, tending, especially for oblate shapes, to reduce the deformation a little; and the magnitude of the potential energy is greatest when precisely those levels are filled for which the kinetic energy is minimized. A picture is suggested in which it is primarily the behavior of kinetic energy that determines the ground-state deformations in this region. (M.H.R.)

23546 S-WAVE NEUTRON STRENGTH FUNCTION AND THE OPTICAL MODEL WITH VOLUME AND SURFACE ABSORPTION. Ganguly, Chhaya; Sil, N. C. (Indian Association for the Cultivation of Science, Jadavpur, Calcutta). Indian J. Phys., 40: 623-6(Nov. 1966).

The s-wave neutron strength function and the potential scattering radius are calculated using a potential that consists essentially of the Woods-Saxon potential and its derivative. (D.C.W.)

23547 PERTURBATION OF RESONANCE STATES AND ENERGY SHIFT IN MIRROR NUCLEI. Humblet, J. (International Centre for Theoretical Physics, Trieste, Italy. Univ. of Liege); Lebon, G. Nucl. Phys., A96: 593-604(1967).

Defining the resonance states of a nucleus according to the S-matrix theory of nuclear reactions, the perturbation of their position and width is calculated to the first order for a given perturbation of the Hamiltonian. The results are applied to the computation of the energy shift of some levels of light mirror nuclei. (auth)

23548 PHENOMENOLOGICAL STUDY OF ROTATION AND VIBRATION MOTIONS IN DEFORMED HEAVY NUCLEI. I. Lebon, G. (Univ., Liege). Bull. Soc. Roy. Sci. Liege, 35: 575-89 (1966). (In French).

A critical analysis of the most important collective phenomenological models describing heavy even-even nuclei is presented, and some improvements are introduced. Two groups of models are discussed: in the first one, the equilibrium shape of the nucleus is supposed to be an asymmetric spheroid; in the second one, it is a symmetric spheroid. The asymmetric-rotator model is considered, and an exact treatment of the coupling between rotation and vibration motions is given. (auth)

23549 PHENOMENOLOGICAL STUDY OF ROTATION AND VIBRATION MOTIONS IN DEFORMED HEAVY NUCLEI. II. Lebon, G. (Univ., Liege). Bull. Soc. Roy. Sci. Liege, 35: 590-607(1966). (In French).

A study is made of the rotation-vibration interaction in even-even nuclei by perturbation methods. Theoretical results are compared with experimental data. The results obtained by asymmetric models are compared with those given by symmetric ones. (auth)

23550 DISPERSION FORMULA FOR ELASTIC SCATTERING BY A CENTRAL POTENTIAL. Humblet, J.; Jeukeene, J. P. (Univ., Liege). Bull. Soc. Roy. Sci. Liege, 35: 608-26(1966). (In French).

A dispersion formula is given for the collision matrix corresponding to the elastic scattering of a neutral particle by a central force. It is composed of three types of terms: (1) the so-called hard-sphere scattering, (2) a polynomial, the degree of which does not exceed unity in practical cases, and (3) a series of resonance terms. This expansion is more appropriate to numerical computations than another one given earlier, but, although the collision matrix is not explicitely dependent on the potential range, the latter explicitely appears in each term of the expansion given. (auth)

23551 DIFFERENT APPROXIMATIONS OF THE ELASTIC SCATTERING CROSS SECTION FOR A CENTRAL POTENTIAL. Jeukenne, J. P. (Univ., Liege). Bull. Soc. Roy. Sci. Liege, 35: 627-36(1966). (In French).

Two different expansions of the cross section for the elastic scattering of neutral particles are applied to a square-well potential. One- and few-level approximations for both expansions are computed. An argument in favor of the expansion is brought forward, leading to a well determined background term when the potential is given a priori, especially if strongly bound states exist. However, it is confirmed even in an unfavorable case of broad resonance levels, that such levels play a major part in the parametrization of the cross section. (auth)

23552 EVAPORATIVE DATA ON INTERMEDIATE RESONANCES IN NUCLEAR REACTIONS. Lang, Donald W. (Argonne National Lab., Ill.). Nucl. Phys., A96: 273-8(1967).

The data on high-energy tails of evaporative spectra are interpreted in terms of "intermediate resonances," and the widths and spacings of these resonances are estimated. The estimated widths are close to the limits of present techniques of observation. It appears that the levels should overlap strongly. Cross correlations and other properties that help in identification are discussed. (auth)

23553 CONSTRUCTION OF INVARIANTS FROM CLEBSCH-GORDAN COEFFICIENTS. Strobel, George L. (Univ. of California, Davis). Nucl. Phys., A96: 229-37(1967). (UCD-CNL-69).

A diagrammatic technique is developed which enables one to recognize the sum of a series of products of Clebsch-Gordan coefficients. Algebraic manipulation is replaced by the far simpler recognition of patterns in diagrams. (auth)

23554 A SIMPLIFIED EXPRESSION FOR THE TALMI COEFFICIENTS. Bakri, M. M. (Cairo Univ.). Nucl. Phys., A96: 115-20(1967).

An expression is derived for the Talmi coefficients for two particles with unequal masses, which is much simpler than that given previously by Smirnov. This is achieved by using a theorem proved recently, stating that the expansion coefficients of the two-particle function $r_1^{2n_1+l_1} r_2^{2n_2+l_2} Y_{l_1 m_1}^{(n_1)} Y_{l_2 m_2}^{(n_2)}$ in terms of functions of the cms and relative coordinates are, apart from a normalization factor, the Talmi coefficients. (auth)

23555 COMPLEX ANGULAR MOMENTUM IN NUCLEAR REACTIONS. Treacy, P. B. (Australian National Univ., Canberra). Nucl. Phys., A96: 145-58(1967).

The scattering amplitude and reaction lines shapes in a spinless charged-particle channel are analyzed in terms of poles in angular momentum. The case of ^{4}He plus ^{4}He is considered as an example of the one-pole approximation. Practical difficulties are considered in regard to lack of unitarity, wrong threshold behavior, and ambiguity of background, in the representation. A modified representation is proposed, from which these difficulties have been eliminated. (auth)

23556 TRENDS IN NUCLEAR REACTION CROSS SECTIONS. IV. RECALCULATED (n,p) CROSS SECTIONS FOR 14.5-MeV NEUTRONS OF NUCLEI IN THE RANGE 6 less than or equal to Z less than or equal to 50. Gardner, Donald G. (Univ. of California, Livermore. Illinois Inst. of Tech., Chicago); Rosenblum, Sheldon. Nucl. Phys., A96: 121-37(1967). (UCRL-14951).

In 1962 rough estimates were published of the absolute values of (n,p) cross sections of all stable isotopes of most of the elements. In this work, the relative (n,p) cross sections for isotopes of elements in the range $6 \leq Z \leq 50$ are calculated using an equation, derived previously with the statistical model approach, in which only the level density parameter, Q-value, pairing energy, effective Coulomb barrier, and the energy of the incident neutron appear. The relative cross sections are used to compute absolute cross sections with the aid of an empirical equation. The latter cross sections agree with experiment in over 80% of the cases. The present calculations are compared with the predictions of the empirical equations of Levkovskii, and possible sources of shell effects in the observed cross sections are discussed. (auth)

23557 CALCULATION OF EQUIVALENT LOCAL POTENTIALS AND AN INVESTIGATION OF THEIR l-DEPENDENCE. Fiedeldey, H. (Atomic Energy Board, Pelindaba, South Africa). Nucl. Phys., A96: 463-75(1967).

A general iteration method for the calculation of equivalent local potentials for arbitrary nonlocal potentials is given. An exact expression is obtained for the equivalent local potential if the nonlocal problem is assumed to have been solved already. For nonlocal potentials of the type introduced by Frahn and Lemmer and extensively used by Perey and Buck, the iteration procedure is applied and the l-dependence of the equivalent local potential is investigated. For this special case, the l-dependence is found to be negligible in the nuclear surface region. (auth)

23558 ALPHA DISTRIBUTION ON THE NUCLEAR SURFACE FROM SHELL MODEL. Sharma, R. C. (Sir George Williams Univ., Montreal). Nucl. Phys., A96: 410-16(1967).

An attempt is made to match the distributions of alpha particles on the surface of doubly even nuclei, calculated from observed branching ratios with the distributions predicted by the shell-model assignments for the outermost nucleons (overlap model). The distributions calculated from the assignments made in case of ^{228}Th, ^{230}U, ^{234}U, ^{238}Pu, ^{242}Cm, ^{246}Cf, and ^{254}Fm are compared with semi-empirical ones, with encouraging results. It is concluded that at ^{242}Cm the neutrons start filling at the equator of a prolate spheroidal nucleus rather than at the pole. (auth)

23559 LINEAR TRANSFORMATION CONNECTING MASS-CENTER AND LABORATORY WAVE FUNCTIONS OF TWO PARTICLES. Bakri, M. M. (Cairo Univ.). Nucl. Phys., A96: 377-84(1967).

A unitary linear transformation connecting the cms and laboratory coordinates of two particles is derived. This transformation possesses an O_3 symmetry, which defines classes of functions of two vectors having the same transformation matrix. In particular, the wave functions of the three-dimensional harmonic oscillator are shown to transform as $r_1^{2n_1+l_1} r_2^{2n_2+l_2} Y_{l_1 m_1}(r_1) Y_{l_2 m_2}(r_2)$; the transformation matrix elements are the Talmi coefficients. (auth)

23560 POLARIZATION IN ELASTIC SCATTERING AT LOW ENERGIES. Varma, S. (Weizmann Inst. of Science, Rehovoth, Israel). Nucl. Phys., A97: 282-8(1967).

An analytic expression is derived for the polarization of spin-½ particles in elastic scattering at low energies. The derivation is based on the strong absorption model. The kind of fit obtained is illustrated for a few cases. (auth)

23561 COMPARISON BETWEEN R-MATRIX AND SHELL-MODEL APPROACHES TO NUCLEAR REACTIONS. Mahaux, C. (Univ. of Liege. Univ., Heidelberg); Weidenmueller, H. A. Nucl. Phys., A97: 378-404(1967).

The elements of the collision matrix can be written as a ratio of two determinants in the R-matrix theory as well as in the shell-model approach to nuclear reactions. The formal structure of the corresponding determinants and the energy dependence of all analogous quantities is shown to be approximately the same in both theories. Thus, many models constructed in the framework of one of the two theories can easily be transferred into the other formalism. This correspondence is exhibited for several models of intermediate structure phenomena. Nevertheless, the two theories differ appreciably in content. The definitions and values of the analogous quantities can be very different, although their energy dependence is similar. This statement is illustrated by a numerical example which also shows that the "natural" boundary condition of R-matrix theory is usually not the most appropriate one for the open channels. It is argued that the parameters extracted from a fit of an experimental cross section with the R-matrix parametric expressions are usually more directly connected with the shell-model parameters than with those of R-matrix theory. (auth)

23562 EQUILIBRIUM DEFORMATIONS OF HEAVY NUCLEI CALCULATED WITH PROJECTED WAVE FUNCTIONS. Sobiczewski, A. (Joint Inst. for Nuclear Research, Dubna, USSR). Nucl. Phys., A96: 258-72(1967).

The ground-state equilibrium deformations, electric quadrupole moments, and deformation energies are calculated for even nuclei in the heavy element region. Projected wave functions (PBCS) corresponding to a definite number of particles are used. It is found that the main effect of using the PBCS wave functions instead of the BCS wave functions appears at the beginning of the region and consists in the earlier appearance of the deformation and in its larger values. (auth)

23563 A LOCAL POTENTIAL APPROXIMATELY EQUIVALENT TO THE NONLOCAL OPTICAL POTENTIAL OF PEREY AND BUCK. Gersten, A. (Weizmann Inst. of Science, Rehovoth, Israel). Nucl. Phys., A96: 288-304(1967).

Explicit expressions are obtained for a local potential approximately equivalent to the optical nonlocal potential of Perey and Buck for elastic neutron scattering. Expressions are also obtained for the parameters of the local potential in terms of those of the nonlocal potential. On the basis of these expressions, the dependence of the local potential parameters on neutron energy, mass of the target nucleus, and the parameter of non-locality are examined. (auth)

23564 ANALYTICITY OF THE COULOMB-NUCLEAR S-MATRIX FOR COMPLEX ANGULAR MOMENTA. Klarsfeld, S. (Institut de Physique Nucleaire, Orsay, France). Nuovo Cim. (10), 48A: 1059-74(Apr. 21, 1967).

The presence of an additional Coulomb interaction is shown to introduce no modification in the analytic structure of the S-matrix for λ complex at fixed $k > 0$. Moreover, it is found that the asymptotic behavior of the "nuclear" partial-wave amplitude for $\lambda \to \infty$, $|\arg \lambda| < \pi/2$, is essentially the same as in the non-Coulomb case. (auth)

23565 PROTON-NUCLEUS REACTION CROSS SECTIONS COMPUTED FROM ELASTIC-SCATTERING DATA. Sannes, F.; Stairs, D. G. (McGill Univ., Montreal). Can. J. Phys., 45: 1497-1500(Apr. 1967).

Proton-nucleus reaction cross sections in the energy region from 90 to 300 MeV are calculated from elastic-scattering data. The interference of the nuclear scattering amplitude with the calculable Coulomb scattering amplitude determines the magnitude and phase of the nuclear amplitude when the differential elastic-scattering cross section is known. The reaction cross section is then obtained by an application of the optical theorem. (auth)

23566 GENERALIZED POTENTIALS FOR INELASTIC SCATTERING. Volkin, Howard C. (Lewis Research Center, Cleveland). Phys. Rev., 155: 1177-90(Mar. 20, 1967).

The projection-operator method is used to derive the generalized potential which gives the scattering into a selected group of inelastic channels as well as the elastic scattering. The projectors employed for this purpose are related to the projector which selects all open channels. The example of pickup or stripping processes is discussed to illustrate the general relations. Feshbach's unified theory of nuclear reaction is then used to separate the rapidly varying or resonance part of the potential from the part which varies slowly with energy. Suitable energy averaging of the transition amplitudes leads to the generalized optical potential. Some of the properties of the potentials are discussed. (auth)

23567 NUCLEAR INTERACTIONS AND K-BREAKING MECHANISMS. Kahana, S.; Weneser, J. (Brookhaven National Lab., Upton, N. Y.). Phys. Rev., 155: 1156-63(Mar. 20, 1967). (BNL-10567).

K-breaking interactions, additional to the usual Coriolis terms, are deduced from velocity-dependent interactions and shown to be of the same order as those contributed by the Coriolis force. Similar considerations, when turned towards the weak interactions, yield a term that simultaneously breaks K and mixes parity. (auth)

23568 TWO- AND FOUR-QUASIPARTICLE STATES IN SPHERICAL VIBRATIONAL NUCLEI. Pal, M. K.; Gambhir,

Y. K.; Raj, Ram (Saha Inst. of Nuclear Physics, Calcutta). Phys. Rev., 155: 1144-55(Mar. 20, 1967).

Expressions are derived in the modified Tamm-Dancoff (TD) approximation which take into account the mixing of zero-, two-, and four-quasiparticle states for the description of the collective vibrational states of spherical nuclei. The proposed method is free from two very important defects inherent in the higher random-phase approximation (HRPA), namely, nonorthonormality and redundancy of the four-quasiparticle basic states. The relative merits of the present method over the existing one (HRPA) are discussed. (auth)

23569 EFFECT AND TREATMENT OF LONG-RANGE FORCES IN THE THEORY OF NUCLEAR MATTER. Rajaraman, R. (Univ. of Southern California, Los Angeles). Phys. Rev., 155: 1105-10(Mar. 20, 1967). (USC-136-113).

The effect and treatment for the long-range part of nuclear forces in the theory of nuclear matter is discussed. From a study of the matrix elements of this potential v_1, the diverse contributions of v_1 to first order (-38 MeV), second order (-1 MeV), third order (-5 MeV), etc., are reconciled to each other. The ideas are then extended to all three-body, four-body, and higher-cluster diagrams of all orders in perturbation where it is shown that the leading contribution of v_1 comes from diagrams containing only one long-range interaction and the rest short range. It is also shown that this long-range interaction must occur in diagonal form, i.e., as a "bubble insert." It is finally pointed out that, using the familiar Hartree method, these bubble inserts can be included in the single-particle energies, thereby absorbing most of the effect of v_1 on higher clusters. (auth)

23570 INFORMATION OBTAINABLE FROM THE NONCOPLANAR (p,2p) REACTION. Jackson, Daphne F. (Univ. of Surrey, London). Phys. Rev., 155: 1065-9(Mar. 20, 1967).

A description of the symmetric noncoplanar (p,2p) reaction is given in terms of the distorted-wave impulse approximation and using a simple model of the three-body final state. It is shown that a study of noncoplanar scattering could give information on the population of substates in the final nucleus and on the way this is affected by distortion. Through such a study the advantages of the (p,2p) reaction as a correlation experiment can be realized. It is also shown that coplanar and noncoplanar scattering are sensitive to deformation of the target nucleus and that a combined study of these processes could provide a method of investigating the spatial distribution of bound protons in nonspherical nuclei. A possible experimental arrangement for the noncoplanar scattering is discussed. (auth)

23571 QUASI-ELASTIC SCATTERING NEAR ZERO RECOIL MOMENTUM. Elton, L. R. B.; Jackson, Daphne F. (Univ. of Surrey, London). Phys. Rev., 155: 1070-2(Mar. 20, 1967).

Finite resolution in the detectors in a coplanar symmetric (p,2p) experiment leads to out-of-plane scattering which is dominant over in-plane scattering when the cross section has a minimum. The amount of filling that this causes is calculated and compared with experiment. (auth)

23572 COLLECTIVE TREATMENT OF THE GIANT RESONANCES IN SPHERICAL NUCLEI. Huber, M. G. (National Bureau of Standards, Washington, D. C.); Danos, M.; Weber, H. J.; Greiner, W. Phys. Rev., 155: 1073-84(Mar. 20, 1967).

In a collective treatment the energies of the giant resonances are given by the boundary conditions at the nuclear surface, which is subject to vibration in spherical nuclei. The general form of the coupling between these two collective motions is given by angular-momentum and parity conservation. The coupling constants are completely determined within the hydrodynamical model. In the present treatment the influence of the surface vibrations on the total photon-absorption cross section is calculated. It turns out that in most of the spherical nuclei this interaction leads to a pronounced structure in the cross section. The agreement with the experiments in medium-heavy nuclei is striking; many of the experimental characteristics are reproduced by the present calculations. In some nuclei, however, there seem to be indications of single-particle excitations which are not yet contained in this work. (auth)

23573 PROPERTIES OF THE PROJECTED SPECTRA FOR FINITE NUCLEI. Warke, Chindhu S. (Tata Inst. of Fundamental Research, Bombay); Gunye, M. R. Phys. Rev., 155: 1084-9(Mar. 20, 1967).

The general features of the expressions useful for numerical calculations of the projected deformed Hartree-Fock (HF) spectra for finite nuclei are investigated. It is proved that the projected deformed HF wavefunction gives the possible nuclear spins as $I = 0, 2, 4, \ldots, I_{max}$ for a $K = 0$ band and $I = K, K+1, \ldots, I_{max}$ for a $K \neq 0$ band. It is further proved that if the energy $E_{I=K}$ of the projected $I = K$ state is greater (less) than the HF energy E_K^{HF}, then E_I is greater (less) than $E_{I'}$ for $I < I'$. A plausible reason why one should use the deformed HF state rather than any other deformed state is also pointed out. (auth)

23574 MATRIX METHOD OF CALCULATIONS OF ALPHA-RAY SPECTRUM OF THICK SOURCES. Grigorov, V. P. At. Energ. (USSR), 21: 517-18(Dec. 1966). (In Russian).

Monoenergetic alpha particles are assumed. The thickness of the source H_0 is comparable with the range R_0 of the alpha particle in the source. The distribution of the alpha emitter as a function of density is known. An expression in terms of the above parameters is given for the relative number of alpha particles N emitted from the source. Then the range of the alpha particle R_0 is broken up into m sections, and the source is divided into k layers having a thickness of Δh. An expression is then given for the relative number of alpha particles $N(r_i)$ transversing the path from r_{i-1} to r_i. On assigning various values from 1 to m to the index i, a total of m equations is obtained whose solution gives the discrete spectra of alpha particles in the source. This set of equations can be described in the form of a single matrix equation: $N = BA$. Here N and A are single-column matrices containing m and k elements, respectively; and the elements of the matrix B are calculated for concrete values of Δh and Δr. H_0 and R_0 are separated into sections in such a manner that the alpha particle loses the same amount of energy in each section. Elements of the matrix A are determined by using an auxiliary graph. The B matrix is multiplied by the A matrix to give the energy spectrum of the alpha particles. (TTT)

23575 CALCULATION OF THE INTENSITY OF X RAYS PRODUCED BY MOESSBAUER ABSORPTION. Gelberg, A. (Univ., Bucharest); Nistor, C.; Protop, C. Rev. Roum. Phys., 11: 911-16(1966). (In French).

The intensity and shape of the characteristic x-ray which appears when a gamma ray is resonantly absorbed and the nuclear state excited decays by internal conversion are calculated. A method of measuring internal conversion coefficients using Moessbauer x-ray spectra is outlined. (D.C.W.)

23576 CLOSE-PACKED-SPHERON THEORY OF NUCLEAR STRUCTURE AND THE NEUTRON EXCESS FOR STABLE NUCLEI. Pauling, Linus (Center for the Study of Democratic Institutions, Santa Barbara, Calif.). Rev. Roum. Phys., 11: 825-33(1966).

The close-packed-spheron theory of nuclear structure provides a structural interpretation of the observed values of the excess of neutrons over protons in the stable nuclei. It is found that for magic neutron numbers the isotope with the largest atomic number has a neutron excess equal to the number of core neutrons, and the stable isotope with odd atomic number has a neutron excess 3 greater than the number of core neutrons. These observations indicate that one requirement for stability is that the number of protons in a nucleus shall not be so great as to prevent all of the protons from entering the outer layer of spherons (the mantle of the nucleus). The observed values of the number of excess neutrons for stable nuclei indicate that cores containing 8 and 20 neutrons are especially stable, and that those containing 14 and 16 neutrons are unstable. (auth)

23577 MODEL FOR THE STUDY OF THE INTERFERENCE OF THE DIRECT AND COMPOUND-NUCLEUS REACTION MECHANISMS. Ratcliff, K. F. (Univ. of Rochester, N. Y. Univ. of Pittsburgh); Austern, N. Ann. Phys. (N. Y.), 42: 185-21(Apr. 1967).

A model is proposed for the investigation of the interference of direct and compound-nucleus reaction mechanisms in the inelastic scattering of nucleons. The continuum eigenfunction is considered to consist of a sum of two types of components: Product functions represent the nonlocalized open-channel or scattering components. Closed-channel or compound-nucleus components are represented by localized functions. The direct reaction mechanism is characterized by the set of matrix elements of the nucleon-nucleus interaction that couple two open-channel components. The compound-nucleus reaction mechanism is characterized by the matrix elements that couple open- and closed-channeling components. The formal development of the above model is essentially a simple application of Feshbach's unified theory of nuclear reactions. However an additional "surface-transition model" is employed, in which the coupling of the various open- and closed-channel components is restricted to occur at one value of the nucleon-nucleus separation. Within this model, the effective Schrödinger equation is completely solvable, and an analytic expression for the collision matrix is derived. This expression indicates clearly the dynamical interference between the reaction mechanisms; namely, it indicates the nonlinear manner in which the two mechanisms contribute to the collision matrix. The collision matrix is further investigated in two situations. The case of an isolated compound-nucleus state is considered and the departures from the form of a direct term plus Breit-Wigner term

are examined. The case of a dense set of overlapping compound-nucleus states is also treated. Here the energy-averaged collision function is compared to that which would arise in the absence of any compound mechanism. (auth)

23578 BINDING AND SATURATION OF NUCLEAR MATTER BY THE REFERENCE SPECTRUM METHOD. Bhargava, Purna C.; Sprung, Donald W. L. (McMaster Univ., Hamilton, Ont.). Ann. Phys. (N. Y.), 42: 222-61(Apr. 1967).

The properties of nuclear matter was calculated for the Hamada–Johnston, Reid, and Bressel–Kerman potentials by the reference-spectrum method. Inclusion of three-body cluster effects according to the theory of Bethe leads to good agreement with experiment. The methods of calculation are discussed. The third-order reference spectrum correction term is derived and is shown to be important for the $^3S-^3D$ state where the tensor force acts. The soft-core Bressel potential gives about 2-MeV extra binding but saturates at a higher density. The potential energy of particle-states is attractive and depends quite strongly on momentum. It is found that the reference-spectrum parameters should have values near $\Delta = 0.6$ and $m^* = 0.98$. (auth)

23579 NONLOCAL POTENTIALS AND THE ENERGY DEPENDENCE OF THE OPTICAL MODEL FOR NEUTRONS. Engelbrecht, C. A.; Fiedeldey, H. (Atomic Energy Board, Pelindaba, South Africa). Ann. Phys. (N. Y.), 42: 262-95(Apr. 1967).

The energy dependence of the nuclear optical-model potential for neutrons is derived from a nonlocal formalism. The imaginary part of the potential changes continuously from purely surface absorption at zero energy to purely volume absorption at energies beyond 100 MeV. Most of the parameters are determined by demanding that the equivalent local potential at zero energy coincide with the Moldauer potential while the remaining parameters are varied to fit the total and nonelastic cross sections of various spherical nuclei between 30 and 150 MeV. The resulting potential also produces good fits to elastic angular distributions, and, when an appropriate spin-orbit potential is added, to polarization measurements in this energy region as well as the intermediate region between 7 and 24 MeV. This shows that the energy dependence could be described in terms of nonlocality of the interaction and provides a simple local potential which can be used over the whole energy range from 0 to 150 MeV and probably even beyond. (auth)

23580 ANALYTICAL SOLUTION OF IDEAL STRIPPING OR DIFFRACTION PROBLEMS. Albeverio, Sergio (Eidgenoessische Technische Hochschule, Zurich). Helv. Phys. Acta, 40: 135-84 (1967). (In German).

The explicit analytical solution of a model previously discussed by R. Jost is given. The model can be interpreted as describing an idealized quantum-mechanical stripping process (in which two particles moving each in one dimension and forming together a bound state via a δ-function interaction are smashed against a wall which repels one of the particles perfectly) or the diffraction of a plane electromagnetic wave by a wedge of angle 45°, formed by a plane perfectly reflecting mirror and an infinitely thin dielectric plane sheet of infinite dielectric constant, the incident wave being a surface wave linear polarized with its electric vector parallel to the edge of the wedge. A construction of the solution is carried through using a theory of difference equations with periodic coefficients which was given by R. Jost. The solution is first obtained in terms of abelian integrals and theta functions for a hyperelliptic surface of genus 3 and is then reduced to an expression involving only elliptic quantities. (auth)

23581 COLLECTIVE COULOMB EXCITATION OF NUCLEI IN A REGULAR CRYSTAL. Kagan, Yu. M.; Chukhovskii, F. N. JETP Lett. (USSR)(Engl. Transl.), 5: 133-6(Mar. 1, 1967).

Translated from Zh. Eksp. Teor. Fiz., Pis'ma Redaktsiyu, 5: 166-70(Mar. 1, 1967).

Charged-particle scattering by nuclei in crystals with the excitation of collective states that are spread over the entire crystal is considered. The total cross section for coherent gamma emission in the decay of such a state is calculated. (D.C.W.)

23582 VIRTUAL COULOMB EXCITATION IN NUCLEON TRANSFER. Breit, G. (Yale Univ., New Haven). Proc. Nat. Acad. Sci. U. S., 57: 849-55(Apr. 1967). (Yale-1807-41).

The effect of virtual Coulomb excitation (VCE) on nucleon-transfer reactions was calculated with particular attention to low-energy data for the reaction $^{14}N(^{14}N,^{13}N)^{15}N$. If the effect of rapid phase variations of the Coulomb-excited wave function is omitted, the effect of VCE on neutron transfer takes on values similar to some early estimates. If the rapid phase variations are taken into account, this VCE contribution drops to values much smaller than those expected from the tunneling process. The reduction of contributions to the VCE nucleon-transfer effect from the region of space contributing mostly to tunneling is so strong that the establishment of true upper limits is not claimed. (D.C.W.)

23583 METHODS IN COMPUTATIONAL PHYSICS. ADVANCES IN RESEARCH AND APPLICATIONS. VOLUME 6. NUCLEAR PHYSICS. Alder, Berni; Fernbach, Sidney; Rotenberg, Manuel (eds.). New York, Academic Press, 1966. 314p. $13.50.

Papers(6) are included dealing with optical-model calculations, numerical methods for the many-body theory of finite nuclei, application of the Hartree-Fock method to problems in nuclear structure, variational calculations in few-body problems using the Monte Carlo method, automated shell-model calculations, and N–N phase-shift analysis using chi-squared minimization. (D.C.W.)

REACTOR TECHNOLOGY

Central Power Reactors

Refer also to abstracts 22080, 22189, 22771, 22852, 22853, 22868, 22869, 22897, 22903, 23038, and 23705.

23584 (ACNP-64638) SAFETY INSTRUMENTATION REVIEW AND RESULTING MODIFICATIONS FOR PATHFINDER POWER PLANT. (Allis-Chalmers Mfg. Co., Bethesda, Md. Atomic Energy Div.). Feb. 12, 1965. 180p. (DOCKET-50-130(Amend.27)(Att.2)). Dep. mn. CFSTI $3.00 cy, $0.65 mn.

The design criteria for safety instrumentation and design approach to plant safety are discussed. Safety objectives and safety design principles are described for the Pathfinder Atomic Power Plant. A description of the safety system is included with reviews of the three barriers, fuel cladding, reactor vessel and primary system, and the reactor containment building. Process safety instrumentation and nuclear safety instrumentation are summarized. Modifications in design and control rod drive circuits are presented. (J.C.W.)

23585 (AE-269) EXPERIMENTAL EQUIPMENT FOR PHYSICS STUDIES IN THE AGESTA REACTOR. Bernander, G.; Blomberg, P. E.; Dubois, P.-O. (Aktiebolaget Atomenergi, Stockholm (Sweden)). Mar. 1967. 27p. Dep. mn.

Comprehensive physics measurements were carried out in connection with the start up of the Agesta reactor. For this purpose special experimental equipment was constructed and installed in the reactor. A description of the experimental equipment used is given along with information relevant to the physics background and the experience gained during the performance. (auth)

23586 (AEEW-R-399) AN ANALYSIS OF WATER REACTOR BURNUP DATA WITH THE METHUSELAH II CODE. Floyd, M.; Hicks, D. (Atomic Energy Establishment, Winfrith (England)). Oct. 1964. 22p. Dep. mn. CFSTI $3.00 cy, $0.65 mn. HMSO 3s. 0d.

The METHUSELAH II code has been used to predict long term reactivity and isotopic changes in the YANKEE, Dresden and NRX reactors. The object of this investigation was to explore the validity of the METHUSELAH II code for burnup predictions. It is shown that, in general, there is a satisfactory measure of agreement and the first core lives of YANKEE and Dresden appear well predicted. However, there are discrepancies in the isotopic composition of the plutonium formed, which appear to be correlated with the degree of hardness of the reactor spectrum. It is demonstrated that plausible changes in the nuclear data could reduce the discrepancies. (UK)

23587 (AI-CE-31) HEAVY WATER ORGANIC COOLED REACTOR. Quarterly Technical Progress Report, January-March 1966. (Atomics International, Canoga Park, Calif. Combustion Engineering, Inc., Windsor, Conn. Nuclear Div.). May 15, 1966. Contract AT(38-1)-430. 184p. Dep. mn. CFSTI $3.00 cy, $0.65 mn.

The engineering and development aspects of the heavy-water organic-cooled reactor for both 1,000-MW(e) and 10,000-MW(t) dual-purpose plants are given. A dual stream reactor concept is also presented. Results are given for the reactor physics calculations. Developments in reactivity control systems, fuel technology, core component handling and storage, and a discussion of the large components are given. Information is included in sections on pressure tube development, transition joint development coolant chemistry, and parameters affecting corrosion film formation. (M.L.S.)

23588 (ANL-7183) FEASIBILITY STUDY OF NUCLEAR STEAM SUPPLY SYSTEM USING 10,000-MW, SODIUM-COOLED BREEDER REACTOR. Hub, K. A.; Charak, I.; Lutz, D. E.; Thompson, D. H.; Gast, P. F.; Meneley, D. A. (Argonne National Lab., Ill.); Keyfitz, I. M. (Westinghouse Electric Corp., Pittsburgh, Pa. Atomic Power Div.). Sept. 1966. Contract W-31-109-eng-38. 210p. Dep. mn. CFSTI $3.00 cy, $0.65 mn.

A conceptual design study was performed to determine the feasibility of a nuclear steam supply system utilizing a very large Na-cooled fast breeder reactor. Na-cooled fast breeder reactor plants of 10,000-MW(t) size should be considered as being evolutionary from nominal 2,500-MW(t) commercial fast reactor designs. Some salient features of the design studied include: an annular-type reactor having carbide fuel in the core; a reactor outlet temperature of 1,050°F; steam conditions of 2,400 psia and 900°F with live-steam reheat of 660°F; estimated fuel-cycle cost of 0.25 mill/kWh under reference conditions; reactor performance that provides a 7-yr doubling time for total fissile Pu inventory; and plant availability of 92%. Control and safety problems were determined not to be significantly more burdensome than with the proposed nominal 1,000-MW(e) fast reactor designs. The predication that fast reactors will be commercially competitive early in the 1980 era provides the basis for using large pieces of equipment and for finding that a 10,000-MW(t) plant may be constructed later in the same era without an additional development program. (auth)

23589 (ANL-7308) REACTOR DEVELOPMENT PROGRAM PROGRESS REPORT, FEBRUARY 1967. (Argonne National Lab., Ill.). Mar. 28, 1967. Contract W-31-109-eng-38. 106p. Dep. mn. CFSTI $3.00 cy, $0.65 mn.

Regular and special fuel pins were removed from the EBWR for analysis of specific isotopes. The fuel in the plutonium zone had an average exposure of 1300 MWd/tonne. A detailed study to determine swelling in the uranium and correlation of this to exposure time and temperature was made. Neutron flux wire irradiation was conducted at low powers to obtain distribution rates of fission and plutonium production in the radial blanket. Radial blanket subassemblies of the Fuel Cycle Facility reactor were examined for external and internal change in physical properties. Foil irradiations were used to measure the relative ^{238}U capture and fission rates and ^{235}U fission rates in ZPR-3. Further studies were also made to determine the effect of the distortion of the flux distribution on the linearity of k_{eff} subcritical measurements in reactors with a softened neutron spectrum. In ZPR-6 the effects of Na voiding on the fission densities in ^{235}U and ^{239}U and the capture density of ^{238}U were investigated by foil measurements. Material sample worths and Doppler coefficients were measured for ^{238}U and ^{235}U in the ZPR-9; these results are listed in tabular form. Construction activities are detailed for the ZPPR. Three systems of fission-gas pressure transducers for the FFTF are discussed. Failed fuel detection methods, sensor leads for fluid signals, in-core flowmeters, and fuel-pins are some component systems which are briefly discussed. Irradiation of U-Pu alloy fuels is discussed; ceramic, cermet, and mixed-carbide fuel irradiation is also discussed. A method for the preparation of (U,Pu) C fuel is given. Development of refractory-metal alloys for service in oxygen contaminated systems is detailed; corrosion of jacket and structural materials by Na in the reactor is examined and results presented. Microhardness tests were made on Ni-base alloys; results are presented. A relatively detailed outline for fast reactor fuels is given. In the area of general research and development the following topics are discussed: fast reactor core-parameter study, uses of ^{235}U in a fast-reactor era, neutronic investigations, thermal design studies, and fuel cycle costs. An oscilloscope display for an on-line computer is described; changes in the cross section computer programs are given; reactor parameter calculations are discussed in some detail; fuels and materials development are discussed at length; radiation damage to structural materials is outlined; techniques for fabrication and testing of fuels are presented. Various phases of engineering development are discussed in some detail. Results of corrosion studies for the Argonne Advanced Research Reactor secondary coolant loop are tabulated. A general discussion of the reactor physics measurements and experiments in the AARR is given. A survey of work done in nuclear safety is given; the following subjects are covered: linkage of heat transfer and two-phase coolant flow nodules, Na expulsion, superheat, critical flow, electron-bombardment heater tests, convective instability, thermophysical properties of Na, component dynamics, transient in pile loop experiment with EBR-II Mark I fuels, summary and analysis of single-pin results, seven-pin-cluster Na loop experiments, vacuum-inert gas glovebox, TREAT operations, metal-water reactions, and Pu volatility safety. (M.L.S.)

23590 (BNWL-362) REACTION OF MOLTEN UO_2 WITH WATER. Gibby, R. L. (Battelle-Northwest, Richland, Wash. Pacific Northwest Lab.). Jan. 1967. Contract AT(45-1)-1830. 10p. Dep. mn. CFSTI $3.00 cy, $0.65 mn.

The results of the investigation of fused UO_2 reactions with water at various temperatures are presented. H_2 generation is measured and oxidation products determined. (M.L.S.)

23591 (CEA-R-3070) APPLICATION DE LA METHODE JANVIER (M. YVON) AUX EXPERIENCES PAR NEUTRONS PULSES. (Application of the JANVIER (M. YVON) Method to Pulsed Neutron Experiments). Deniz, Valentin (Commissariat a l'Energie Atomique, Saclay (France). Centre d'Etudes Nucleaires). Dec. 1966. 33p. (In French). Dep. mn.

For the analysis of pulsed neutron experiments, it is important to know the extrapolation length in order to be able to evaluate the bucklings. For moderators in slab geometry, the method JANVIER (M. YVON) is very well adapted to the application of

the boundary conditions. A study of the method is reported here as applied to the pulsed neutron problem and the MILNE problem in the spectral case. It is shown that the first order approximation for the angular expansion is sufficient for obtaining a good value of the diffusion cooling coefficient, even though the ultimate precision depends on the method used to study the spectrum. An expansion of the spectrum in a series of LAGUERRE functions of order one is considered. In the $P_1^+L_1^{(1)}$ approximation, the relative variation of the extrapolation length with buckling for light water is in good agreement with calculations made using the SLOP-1 code. For graphite, the variation is small in the buckling range interesting for experiments. The convergence of the LAGUERRE function expansion being very slow, a new system of orthogonal functions $\epsilon_n^{(s)}(y)$ is proposed, which permits one to express the spectrum as a sum of maxwellians, the set of Maxwellians chosen being defined by the free parameter s. The use of these functions with a conveniently chosen value of s could lead to rapid convergence. (auth)

23592 (CEA-R-3080) LA CINETIQUE DES MILIEUX HETEROGENES. (Kinetics of Heterogeneous Systems). Deniz, Valentin (Commissariat a l'Energie Atomique, Saclay (France). Centre d'Etudes Nucleaires). Jan. 1967. 27p. (In French). Dep. mn.

A general transport theory treatment is presented for the kinetics study as applied to finite heterogeneous systems. The theory is applicable to experiments near the critical point as well as to pulsed neutron experiments on multiplying or nonmultiplying lattices. The general method is also applied to exponential experiments on infinite non-diverging lattices. The particularity of the present study is the explicit introduction of heterogeneity in the formulation and the search for the dependence of the parameters on the buckling of the finite medium. As a result of this, the finite medium parameters are in the first place expressed in terms of the corresponding infinite medium ones through the buckling and the anisotropic migration areas, and in the second place all the parameters are expressed as integrals only over an unit cell instead of over the whole pile. A preliminary less detailed study is first made in order to distinguish clearly between what are called "dynamic parameters" and "static parameters," and to define the meanings given in this report to these two terms. In the appendices are given approximate one-group treatments for the study of the dynamic fine structure, the time constant in infinite lattices, and the anisotropic diffusion coefficients in nonmultiplying lattices. (auth)

23593 (CEND-289) SETUP OF ISOCHECK METHOD FOR DETERMINING HEAVY-ISOTOPE CONTENT IN THE OPERATING FUEL ELEMENTS OF DRESDEN I CORE IV. Kern, Richard; Shesler, Albert T. (Combustion Engineering, Inc., Windsor, Conn. Nuclear Div.). Jan. 16, 1967. Contract AT(38-1)-428. 117p. Dep. mn. CFSTI $3.00 cy, $0.65 mn.

A method is given for determination of heavy-isotope content in fuel elements which are in operation. The method consists of calculation of assembly-by-assembly exposure for successive power intervals by use of FLARE code and the determination of assembly-to-assembly isotopic composition. Methods of determining input for FLARE are discussed rather thoroughly. The use of the ISOCHECK system for checking fuel inventory with FLARE input is discussed at length. Results of the development of the ISOCHECK method for the Dresden I Reactor Core are given. (M.L.S.)

23594 (CEND-290) SETUP OF ISOCHECK METHOD FOR DETERMINING HEAVY-ISOTOPE CONTENT IN THE OPERATING FUEL ELEMENTS OF OYSTER CREEK CORE I. Kern, Richard; Shesler, Albert T. (Combustion Engineering, Inc., Windsor, Conn. Nuclear Div.). Jan. 23, 1967. Contract AT(38-1)-428. 40p. Dep. mn. CFSTI $3.00 cy, $0.65 mn.

Specific application of the ISOCHECK method to Oyster Creek Core I is straightforward in that no distortion of reactor geometry or serious compromises in the representation of core compositions are required. Hence, the degree of accuracy generally characteristic of the state-of-the-art of reactor physics for water reactors should be obtainable in the use of the method. Accuracies of ±5% for ^{235}U depletion and of ±8% for total Pu content can be expected for normal batches of operating fuel elements in the reactor. The accuracies apply for the batch as a whole, which may consist of 20 or more fuel assemblies. The batch is the smallest unit of interest, insofar as isotopic content for fuel accounting purpose is concerned, because fuel reprocessing occurs in batch loads. (auth)

23595 (CEND-295) ENRICHMENT REQUIREMENTS FOR BONUS BOILER FEED FUEL AND REPLACEMENT SUPERHEATER FUEL. Valerino, Michael F. (Combustion Engineering, Inc., Windsor, Conn. Nuclear Div.). Feb. 1967. Contract AT(40-1)-2674. 117p. Dep. mn. CFSTI $3.00 cy, $0.65 mn.

Results of analyses performed to determine the feed enrichment of the BONUS boiler fuel and the enrichment of the replacement BONUS superheater fuel are presented. FLARE calculations—which treat burnup, fuel switching, and core geometry according to a one-group diffusion theory—will also minimize later calculations for refueling. Rough estimates of maximum-to-average power density ratio in the boiler and superheater are also made. Specifications of enrichment for an alternate superheater fuel assembly are also considered. (M.L.S.)

23596 (COO-284(Vol.2)) SMALL NUCLEAR POWER PLANTS. VOLUME TWO. THE INDUSTRIAL EXPRESSION OF SUPPLY AND DEMAND CONSIDERATIONS. (Chicago Operations Office (AEC), Ill. Reactor Engineering Div.). Mar. 1967. 164p. Dep. mn. CFSTI $3.00 cy, $0.65 mn.

Information prepared by personnel in the nuclear industry and electric utilities representing the present supply and demand situation is presented. Manufacturers provided brief descriptions of plants for utilities having a need for power plants in sizes smaller than 100 MW. The organizations representing small utilities presented the manufacturers a statement of their needs and the utility data pertinent to application and economics. These analyses show the status for small power reactors and indicate the improvement necessary in the level of economic performance to establish competitive nuclear energy costs. (J.R.D.)

23597 (COO-284(Vol.3)) SMALL NUCLEAR POWER PLANTS. VOLUME THREE. A GENERAL AND ECONOMIC ASSESSMENT. (Kaiser Engineers, Oakland, Calif.). Mar. 1967. 160p. Dep. mn. CFSTI $3.00 cy, $0.65 mn.

Capital and power generation costs for small nuclear power plants are estimated under existing conditions (present costs) and under a set of future achievable conditions which would result in substantial cost reductions (reduced costs). A small nuclear power plant is defined for the study as one having a net electric capacity of 100 MWe or less. Plant ratings of 25, 50, and 100 MWe (net) were selected to bracket the range of interest. (J.R.D.)

23598 (EURFNR-268) FAST REACTOR FUEL DEVELOPMENT PROGRAM. Progress Report, June 1–December 31, 1965. Leblanc, J. M. (comp.) (Centre d'Etude de l'Energie Nucleaire, Brussels (Belgium). Societe Belge pour l'Industrie Nucleaire, Brussels). Contract 015-65-1 RAP-B. 60p. (BN-6512-01). Dep. mn. CFSTI $3.00 cy, $0.65 mn.

Work Performed under United States–Euratom Fast Reactor Exchange Program.

The fabrication possibilities of mixed uranium and plutonium oxide fuels are investigated. The fast reactor fuel development consists of the fabrication of Pu oxide fuel pins to be tested in the Enrico Fermi fast reactor and these fuels to meet the requirements for large fast reactors. For pelleted and vibratory compacted fuel pins, the best fabrication processes are examined on the basis of cost and Pu homogeneity. Initial results of the UO_2-PuO_2 fast reactor fuel fabrication development program are reported. (J.C.W.)

23599 (GA-7562) LATTICE PHYSICS STUDIES. Quarterly Progress Report for the Period Ending October 31, 1966. Trimble, G. D.; Gozani, T.; Neill, J. M. (General Dynamics Corp., San Diego, Calif. General Atomic Div.). Nov. 25, 1966. Contract AT(04-3)-167. 54p. (EURAEC-1821). Dep. mn. CFSTI $3.00 cy, $0.65 mn.

Work Performed under United States–Euratom Joint Research and Development Program.

The study of the spatially dependent lattice neutron spectrum for Pu-water lattices is outlined. A two-dimensional transport code, modified to allow printout of directional fluxes, is being used to determine probe-tube perturbations. A Monte Carlo code is being used to compute perturbations due to reentrant holes. The problem of correlation of calculated and measured fluxes has been studied in detail. Results of these studies are presented. Slowing-down source calculations are presented in some detail. Energy sensitive detectors design is described; these will be used to measure mean emission time. A design is given which is to be used for measuring tightly packed lattices. The joint Euratom experimental program is outlined. (M.L.S.)

23600 (GA-7830) 40-MW(e) PROTOTYPE HIGH-TEMPERATURE GAS-COOLED REACTOR POSTCONSTRUCTION RESEARCH AND DEVELOPMENT PROGRAM. Quarterly Progress Report for the Period Ending January 31, 1967. (General Dynamics Corp., San Diego, Calif. General Atomic Div.). Mar. 15, 1967. Contract AT(04-3)-314. 68p. Dep. mn. CFSTI $3.00 cy, $0.65 mn.

Efforts devoted to preparations for experiments to be conducted during the approach to power are reported. Specifications for the Po–Be and Sb–Be neutron source locations in the reactors were revised. Calculations of reactivity changes related to core power and He flow were made for full power conditions. Reactor re-

sponses to safety actions were tested. Preliminary reactor operations conducted at 1 to 10 MW(t) in preparation for approach-to-power tests are described. (J.R.D.)

23601 (IA–1113) BASIC NUCLEAR DATA FOR FAST REACTOR CALCULATIONS. Segev, M.; Yiftah, S.; Gitter, L. (Israel Atomic Energy Commission, Yavne. Soreq Nuclear Research Center). Nov. 1966. 11p. (CONF-661014–50). Dep. mn.

From IAEA Conference on Nuclear Data, Paris, France.

The criticality factor, and the coolant loss and Doppler effects are examined for fast reactors. Given a certain specified accuracy needed in the calculated values of these reactor quantities, what is the corresponding required accuracy in the basic nuclear data used as input? The answer is obtained by using a group-diffusion code to get the corresponding accuracies in group parameters. The latter are interpreted in terms of accuracies in basic nuclear data. The required and available accuracies are compared, and it is found that both average cross sections and resonance parameters for a PuO_2–UO_2 core are insufficiently known. (auth)

23602 (IDO–17187) STEP PROJECT. Quarterly Technical Report, April 1966–June 1966. Dietz, K. A. (ed.) (Phillips Petroleum Co., Idaho Falls, Idaho. Atomic Energy Div.). Jan. 1967. Contract AT(10-1)-205. 164p. Dep. mn. CFSTI $3.00 cy, $0.65 mn.

The SNAPTRAN-2 test program was the destructive test of a SNAP-10A reactor produced by the insertion of 5.1 dollars excess reactivity, which led to a 200 microsecond asymptotic period. Results of measurements of reactor kinetics are given with an interpretation of results. An outline of the mechanical results of the destructive test are given with a discussion of mechanical energy measurements. The radiological aspects of the test including instrumentation and measurements, ground testing program, and airborne activity testing are presented. The chemical and metallurgical post-test analyses are outlined and results which were obtained are given. The fuel pin and fuel element cannister design for the LOFT reactor are given. The reactor physics calculations for the fuel elements are discussed. The effects of a rod ejection incident are considered. Blowdown analyses, both calculated and measured, are given detailed consideration, as is meltdown analysis. Results of an extensive set of radiological measurements are given; these are analysed thoroughly. A description of the semiscale blowdown test program is given. (M.L.S.)

23603 (IN–1061) PM-2A REACTOR VESSEL TEST PROGRAM. Final Report. Mousseau, D. R.; Pruden, J. C.; Gold, S. J.; Porter, N. J.; Tobias, D. A. (Idaho Nuclear Corp., Idaho Falls). Mar. 1967. Contract AT(10-1)-1230. 133p. Dep. mn. CFSTI $3.00 cy, $0.65 mn.

The testing of the PM-2A Reactor Vessel was completed following the deliberate brittle fracturing of the pressure vessel. The test was designed to study the brittle fracture characteristics of an irradiated pressure vessel and was completed in two phases. The first phase provided nondestructive data required for development of a test plan while the second phase consisted of testing to achieve brittle failure. The activities involved in the non-destructive testing, loop design, detector selection and application are described. The pressure testing phase is discussed in detail and data obtained during the final tests are presented. (auth)

23604 (KFK–392) REFERENZSTUDIE FUER DEN 1000 MW(e) DAMPFGEKUEHLTEN SCHENLLEN BRUTREAKTOR (D 1). (Reference Studies for the 1000 MW(e) Steam-Cooled Fast-Breeder Reactor (D 1)). Mueller, A.; Eggers, B.; Haefele, W.; (and others) (Kernforschungszentrum, Karlsruhe (West Germany). Institut fuer Reaktorentwicklung). Aug. 1966. 288p. (In German). Dep. mn.

A reference design study for a 1000 MW(e) steam-cooled fast breeder reactor is presented. The factors governing the selection of the most important reactor parameters are outlined and a description is given of the complete installation. The reactor itself is described in detail and the selection of construction materials are considered. Strength calculations are given for the construction materials. Reactor physical studies and calculations were made. Thermodynamics and coolant engineering descriptions are given for the reactor. The normal operational pattern is outlined. The safety of the reactor is considered in some detail. Cost factors are also calculated. (J.S.R.)

23605 (LA–3650) ADVANCED PLUTONIUM FUELS PROGRAM. Quarterly Status Report, October 1–December 30, 1966. (Los Alamos Scientific Lab., N. Mex.). Dec. 1966. Contract W-7405-eng-36. 74p. Dep. mn. CFSTI $3.00 cy, $0.65 mn.

The release of fission products to Na coolant from failed or deliberately vented reactor fuel elements is investigated. Methods of concentrating U, Pu, long-lived energetic γ emitting isotopes, and short-lived biologically hazardous isotopes at specific locations in the system are discussed. (M.L.S.)

23606 (LA-3651) CRITICAL MASS REDUCTION. Jarvis, George A.; Mills, Carroll B. (Los Alamos Scientific Lab., N. Mex.). Dec. 1, 1966. Contract W-7405-eng-36. 14p. Dep. mn. CFSTI $3.00 cy, $0.65 mn.

Further study into the critical mass of nuclear reactors is outlined. Results of the study are presented. (M.L.S.)

23607 (NAA-SR–12148) PIQUA NUCLEAR POWER FACILITY REACTOR OPERATIONS ANALYSIS PROGRAM. Semiannual Progress Report No. 8, January 1–June 30, 1966. (Atomics International, Canoga Park, Calif.). Dec. 31, 1966. Contract AT(11-1)-Gen-8. 219p. Dep. mn. CFSTI $3.00 cy, $0.65 mn.

The semiannual progress report of the Piqua Nuclear Power Facility covers the following topics: the operating history, exploratory core examination, preliminary evaluation of fuel rod binding, core unloading and probing, inspection of fuel elements and other core components, core modifications, control rod modifications, new core characteristics, film formation studies, core hydraulics studies, irradiation embrittlement studies of reactor intervals, reactivity anomaly, coolant analysis summary, in-core reactor deposits analysis, out-of-core reactor deposits analysis, total oxygen content of PNPF coolant determination, and effect of oxygen on PNPF viscosity. (M.L.S.)

23608 (NP–16685) POWER SUPPLY FOR NEW ENGLAND, 1973–1990 (PRELIMINARY). (Ebasco Services, Inc., New York). [1967]. 81p.

A general survey of the long-range power requirements for the New England area is presented. Consumer requirements and producer capacities are considered and predictions made on which a long-term development program can be based. Economics of such a program is considered in some detail. (M.L.S.)

23609 (NYO–3622-7) APPLICATIONS OF ULTRASONIC ENERGY: ULTRASONIC INSTRUMENTATION FOR NUCLEAR APPLICATIONS. Bimonthly Progress Report No. 32, December 1, 1966–January 31, 1967. (Aeroprojects, Inc., West Chester, Pa.). Feb. 1967. Contract AT(30-1)-3622. 20p. Dep. mn. CFSTI $3.00 cy, $0.65 mn.

Work on the incipient boiling detector was concentrated on investigations of scatter in recently-acquired cavitation data, and two sources of the scatter were identified. Improved thermal uniformity produced by mechanical agitation of the liquid was found to reduce scatter in data acquired for molten tin, indicating the value of agitation in a molten potassium system. Additional scatter was attributed to non-vaporous cavitation; functional control over scatter of this origin is believed exerted by normal operation of the incipient boiling detector at temperature ranges near the boiling point. Work on the ultrasonic flowmeter has concerned the development of pulse-shaping circuitry and the improvement of signal reception in the test apparatus. (auth)

23610 (ORNL–3921) EVALUATION OF HEAVY-WATER-MODERATED ORGANIC-COOLED REACTORS. Kasten, P. R.; Adams, R. E.; Carlsmith, R. S.; (and others) (Oak Ridge National Lab., Tenn.). Jan. 1967. Contract W-7405-eng-26. 378p. Dep. mn. CFSTI $3.00 cy, $0.65 mn.

A technical evaluation of heavy-water-moderated organic-cooled power reactors (HWOCR) was performed based on 1000 MW(e) design concepts supplied by Atomics International and Combustion Engineering (AI–CE) jointly and by Babcock & Wilcox (B & W). The AI–CE plant was designed for the U fuel cycle (carbide fuel), while the B & W core designs were based on use of the Th fuel cycle (oxide and also metal fuels). The HWOCR–U reactor plant showed promise of producing power at a cost of about 3.5 mills/kWh(e) in investor-owned plants of 1000 MW(e) capacity, and the associated average conversion ratio was about 0.7. The HWOCR–Th reactor design conditions showed lower fuel burnup costs than those for the HWOCR–U system, with the average conversion ratio being about 0.8; at the same time, power costs under the reference ground rules for the designs submitted were about 0.4 mill/kWh(e) higher than those for the U-fueled reactor. Changing the design could improve the performance of the Th reactors, but the associated power cost would apparently still be higher than that of the U-fueled reactor. Evaluations of the thermal and hydraulic performance of the reactor cores led to the conclusion that the coolant outlet temperature would not be above 700°F for the designs submitted. Additional testing of the U and Th fuel materials is required to demonstrate that the specified maximum burnup can be achieved under HWOCR operating conditions; tests of organic coolant and its film-forming action under HWOCR conditions need further investigation. Experimental measurements and long-term tests are required to verify the practicality of SAP for HWOCR use. (auth)

23611 (ORNL-3959) ON-SITE FUEL PROCESSING AND RECYCLE PLANT: DESIGN STUDY. Unger, W. E.; Harrington, F. E.; May, J. R.; Scott, S. F.; Washburn, T. N. (Oak Ridge National Lab., Tenn.). Apr. 1967. Contract W-7405-eng-26. 108p. Dep. mn. CFSTI $3.00 cy, $0.65 mn.

Probably the smallest economical fuel reprocessing plant is one operated in conjunction with a nuclear power station to accommodate the fuel discharged from the reactor station and designed to share the facilities and indirect personnel cost of the power station. Establishing an anchor point on the low end of the capacity-vs-unit-cost curve was one of the objects of the Small Plant Study. Other cost advantages, permissible in a small, captive installation, are exploited: the use of contract maintenance and analytical services, unitized equipment design to simplify installation and maintenance operations, and the advantage of a predictable load of a single element design. The Oyster Creek Nuclear Power Station, with two 550-MW(e) [1600 MW(t)] boiling water reactors fueled with Zr-sheathed 2.42% enriched UO_2, and 22,000 Mwd/ton burnup was assumed for the study. The plant design was based on known technology or concepts whose development would be beyond question. The cost study used the Purex solvent extraction fuel processing preceded by a mechanical chop-leach fuel dissolving. The cost of the remainder of the fuel cycle (the preparation of the oxide by the sol-gel process and fuel assembly fabrication) was extrapolated from prior studies. A summary of the estimated costs is presented. (auth)

23612 (ORNL-4037) MOLTEN-SALT REACTOR PROGRAM. Semiannual Progress Report for Period Ending August 31, 1966. (Oak Ridge National Lab., Tenn.). Jan. 1967. Contract W-7405-eng-26. 254p. Dep. mn. CFSTI $3.00 cy, $0.65 mn.

Included are operations of the Molten-Salt-Reactor Experiment and analyses of these operations, component development, pump development, instrument development, materials studies, chemistry, molten-salt breeder reactor design studies, and molten-salt processing studies. (M.L.S.)

23613 (ORNL-4050) BEHAVIOR OF IODINE IN AIR: A RESUME OF THE FIRST SEVEN RUNS CONDUCTED AT THE NUCLEAR SAFETY PILOT PLANT. Wantland, J. L.; Row, T. H. (Oak Ridge National Lab., Tenn.). Apr. 1967. Contract W-7405-eng-26. 115p. Dep. mn. CFSTI $3.00 cy, $0.65 mn.

Tests were conducted at the Nuclear Safety Pilot Plant to investigate the transport behavior of I_2 in air. A limited amount of data on UO_2 transport was also obtained. Since no preferential retention of UO_2 on deposition coupons was observed, we conclude that retention of I_2 was completely independent of the retention of UO_2. Also it is implied that their general transport behaviors were independent. The UO_2 aerosol generated by the plasma torch in these tests was shown to be quite similar to the aerosols produced by arc-image-furnace melting, centered-W resistor melting, and in-pile nuclear melting. Fallout samplers showed an initial rapid decrease of fallout followed by a period of low fallout rate. Operation of the circulating fan for a short period of time at the beginning of a run effectively distributed the aerosol in the containment vessel and slowed down the rate of concentration decrease in the containment vessel. (auth)

23614 (ORNL-4060) LIGHT BULB MODEL OF FISSION PRODUCT RELEASE FROM REACTOR FUELS. Miller, C. E. Jr. (Oak Ridge National Lab., Tenn.). Apr. 1967. Contract W-7405-eng-26. 23p. Dep. mn. CFSTI $3.00 cy, $0.65 mn.

Studies of fission product behavior and characteristics are directed toward the development of mathematical models with which the extent of fission product release can be predicted for a specific set of conditions. One such model has been developed which predicts the release of some fission products from molten reactor fuels. This model assumes that in the presence of a cover gas a boundary layer around the fuel exists and that diffusion through the boundary layer is the rate-controlling step in the release of fission products. Several variables are related to the amount of fission product released. These are the composition and pressure of the cover gas, the temperature, surface area, and amount of the molten fuel, the time molten, and the chemical form of the fission product. The model has been tested with data from several sources and satisfactorily explains the observed behavior of fission products and fuel. (auth)

23615 (ORNL-NSIC-32) INDEXED BIBLIOGRAPHY OF CURRENT NUCLEAR SAFETY LITERATURE-8. (Oak Ridge National Lab., Tenn.). Mar. 1967. Contract W-7405-eng-26. 242p. Dep. mn. CFSTI $3.00 cy, $0.65 mn.

An indexed bibliography of current nuclear safety literature is presented. Nuclear Safety information available since September 1964 is given. Bibliographic items are sorted into 19 categories; consequently, an item may appear in more than one category. Items are listed under the following category headings: General Safety Criteria; Siting of Nuclear Facilities; Transportation and Handling of Radioactive Materials; Aerospace Safety; Accident Analysis; Reactor Transients, Kinetics, and Stability; Fission Product Release; Transport and Removal, Sources of Energy Release under Accident Conditions; Nuclear Instrumentation, Control, and Safety Systems; Electrical Power Systems; Containment of Nuclear Facilities; Plant Safety Features; Radiochemical Plant Safety; Radionuclide Release and Movement in the Environment; Environmental Surveys, Monitoring, and Radiation Exposure of Man; Meteorological Considerations; Operational Safety and Experience; Safety Analysis and Design Reports; and Bibliographies. (M.L.S.)

23616 (PEL-131) FIRE-2: A ONE-DIMENSIONAL REACTOR COMPUTING PROGRAM IN FORTRAN IV FOR MULTI-REGION, MULTI-GROUP REACTORS. Malan, Willemien; van der Walt, R. (Atomic Energy Board, Pelindaba, Pretoria (South Africa)). Dec. 1966. 6p. Dep. mn.

The program is written in Fortran-IV to fit the requirements of an IBM-360 model 40G Computer. Fire-2 contains additions to the original. Fire-code such as buckling option and provisions for calculation of few-group constants. (J.R.D.)

23617 (RISO-M-532) I HVILKET TEMPO KAN DER SKAFFES PLUTONIUM TIL DE HURTIGE FORMERINGSREAKTORER. (Fast Breeders and Plutonium Availability). Bjerge, T. (Danish Atomic Energy Commission, Risoe, Research Establishment). Feb. 1967. 23p. (In Danish). Dep. mn.

In countries making considerable effort to develop fast breeders, it seems generally expected that large prototypes can be operating by mid-1970 and commercial fast breeders of 1000 MW or more from the beginning of the 1980's. Assuming that these reactors will be the most economical for baseload, it is estimated when they can share nuclear electricity production if started on Pu for economy. Curves for estimated nuclear power growth seem to indicate that thermal reactors will be widely needed for plutonium production during the rest of the century. This may lead to increasing uranium prices, and economical thermal reactors with large plutonium production may be very attractive; still more so if development of fast breeders is slower than assumed. (DENM)

23618 (SWRI-1228P4-29) PROPOSED CHANGES IN THE TECHNICAL SPECIFICATIONS FOR THE ELK RIVER REACTOR SYSTEM. Norris, E. B.; Pickett, A. G.; Wylie, R. D. (Southwest Research Inst., San Antonio, Tex. Dept. of Materials Engineering). Feb. 10, 1967. Contract AT(11-1)-1228. 50p. Dep. mn. CFSTI $3.00 cy, $0.65 mn.

The provisions of the Elk River Reactor relating to the integrity of the pressure vessel have been reviewed in the light of information which has been developed to date on the materials, fabricating processes, and inspection of the vessel itself. Proposed changes in the technical specifications and the justification for these changes are made. Data are presented to support the removal of the 250-cycle and five-year limitation which presently exists for the reactor pressure vessel. A summary is presented of the available information to date on the reactor material surveillance program. The detection of extensive stress corrosion cracking in the cladding at the vessel flange led to an analysis of the probability of propagation of these defects at this location in addition to those in the strength welds. It was suggested that a program be initiated to continue studies of the possibility of removal of the reactor internals so that a thorough inspection of the reactor pressure vessel can be made. In the meantime, continuation of the inspections being made with conventional means should be continued. (auth)

23619 (TID-23646) INITIAL STEAM FLOW TESTING THROUGH 40 PERCENT POWER TESTING, PATHFINDER ATOMIC POWER PLANT SIX MONTH REPORT, MAY 19, 1966-NOVEMBER 19, 1966. (Northern States Power Co., Sioux Falls, S. Dak.). Jan. 9, 1967. Contract AT(11-1)-589. 130p. (NSP-6603). Dep. mn. CFSTI $3.00 cy, $0.65 mn.

Results of the initial criticality tests and post-neutron tests are briefly discussed. Detailed information on approach-to-power testing to the 40% full power stage (76 MW(t)) are given. Testing results of the initial steam flow to 40% power, superheater performance, chemistry and radiation monitoring experience to 60% full power, safety systems operations, major system and equipment performance, and containment leakage testing are discussed at length. (M.L.S.)

23620 (TID-23768) 237-MW KRB NUCLEAR POWER PLANT. Quarterly Report No. 14, July 1-September 30, 1966. (Kernraftwerk RWE-Bayerwerk G.m.b.H., Gundremmingen (West Germany)). 49p. (KRB-1966/3). Dep. mn. CFSTI $3.00 cy, $0.65 mn.

Results of initial criticality tests, initial systems checkout, and beginning approach-to-power tests are given. Cost and financing tables are also given. (M.L.S.)

23621 (UJV–1736) VYPOCET VYHORENI PALIVA V TEZKOVODNICH REAKTORECH. (Calculations of Fuel Burnup in Heavy Water Reactors). Kujal, B. (Ceskoslovenska Academie Ved, Rez. Ustav Jaderneho Vyzkumu). 1967. 36p. (In Czech). Dep. mn.

The description of a code for calculation of the course of the burn-up process in an equivalent cell of a heavy water reactor is presented. The concentrations of fuel isotopes, change in the thermal neutron spectrum and other parameters of reactor lattice are determined as functions of burn-up. The description of a code which determines the value of the effective multiplication factor for a one-zone reactor in equilibrium state is also presented. The scheme of continual charge-discharge of whole fuel elements has been adopted. The results and their discussion are given as well. (auth)

23622 (UNC–5166) PERFORMANCE EVALUATION OF HEAT EXCHANGERS FOR SODIUM-COOLED REACTORS. Quarterly Technical Progress Report No. 6, October 1, 1966–December 31, 1966. Dischinger, R. H. (United Nuclear Corp., Elmsford, N. Y. Research and Engineering Center). Jan. 20, 1967. Contract AT(11-1)-1452. 33p. Dep. mn. CFSTI $3.00 cy, $0.65 mn.

The evaluation of the thermal-hydraulic and structural performance of heat exchangers for Na-cooled reactor plants is presented. The evaluation is based on the results of tests of model heat exchangers in the Sodium Components Tests Installation (SCTI). Early data from the "rise to power" tests of the SCTI are utilized to shake down the evaluation procedures for the ALCO heat exchangers. Some tentative observations regarding thermal performance are made. Installation of acoustical transducers was recommended to detect tube impaction on baffles as a result of excessive vibration. Steady-state temperature distributions were calculated for the inner core and perforated tube regions of the ALCO heat exchanger tubesheets. These compare favorably with those predicted by ALCO. Requirements for data acquisition during the dynamic performance tests were reviewed. Assistance was provided to B&W in locating thermocouples in the boiler bundles of their steam generator. Preparation of evaluation procedures for the boiler inlet header of the B&W steam generator was initiated. (auth)

23623 (WAPD–298) RADIOLOGICAL CONTROL: SHIPPINGPORT PWR CORE 1, CORE 2 REPLACEMENT AND THE PWR CORE 2 MODIFICATION PROGRAM. Calley, H. W. Jr.; Kemmet, L. H. (ed.) (Bettis Atomic Power Lab., Pittsburgh, Pa.). Mar. 1967. Contract AT-11-1-GEN-14. 51p. Dep. mn. CFSTI $3.00 cy, $0.65 mn.

The radiological control aspects of the refueling of the PWR Shippingport Atomic Power Station with Core 2 and the modifications performed on other reactor plant systems to accommodate the characteristics of the new core are summarized. The effect that radiological control procedures had upon the overall modification program is also discussed. No attempt is made to discuss those phases of the program which were characteristic of any normal industrial construction effort. Phases of the refueling program are discussed which entail additional or unique radiological controls. The effect of radiation and contamination on specific work tasks and on working conditions in general are discussed with the intention that it will provide instructive information for future work of a similar nature. (auth)

23624 (WCAP–6066) CALCULATION OF LOCAL SPECTRUM AND FUEL COMPOSITION CHARACTERISTICS. Lacey, P. G. (Westinghouse Electric Corp., Pittsburgh, Pa. Atomic Power Div.). Feb. 1967. Contract AT(30-1)-3017. 100p. Dep. mn. CFSTI $3.00 cy, $0.65 mn.

An evaluation of reaction-rate ratios in reactor lattices, including the effect of local neutron flux variations which occur as a result of discontinuities in the regular pattern of fuel rods, is given. This evaluation of the so-called microscopic parameters δ^{25}, ρ^{28}, δ^{28}, MCR and CR (which are actually reaction-rate ratios) embodies: the determination of reaction-rate ratios at beginning-of-life in cold, critical-experiment lattices, including experiment/theory correlations in both asymptotic and perturbed lattice regions; the determination of the change, with fuel depletion, of reaction-rate ratios in an operating core, including correlation with preliminary data obtained by destructive analysis of selected fuel samples from YANKEE Core I. The results of the calculations, the experimental data, and the experiment/theory correlations are presented, along with discussion of the methods of analysis. Inferences concerning the ability of the calculational procedure to predict fuel depletion and net Pu production are made. (auth)

23625 (AEC-tr–6640) ENGINEERING DESIGN AND STRUCTURAL ANALYSIS OF NUCLEAR REACTORS. Mel'nikov, N. P. Translated from pp 1-520 of Konstruktivnye Formy i Metody Rascheta Konstruktsii Yadernykh Reaktorov, 1963. 591p. (IPST-Cat.–1667). CFSTI.

Problems pertaining to reactor design are examined, and a review of reactor design evolution is presented. Theoretical considerations relevant to the shape of reactors are examined, and the design of steel reactor structures is discussed. Information is included on reactor weight, steel fabrication, calculations related to steel reactor vessels, and tank-type reactors, welding effects on tubes and tanks, and determination of stresses in tanks. (J.R.D.)

23626 (ORNL–tr–1504) TABLES OF NEUTRON AND GAMMA CONSTANTS STRAIGHT-LINE ATTENUATION BETWEEN SOURCE AND POINT OF MEASUREMENT WITH ACCUMULATION FACTOR. Barthe, Jean-Pierre. Translated by Gregory L. Boisvert (Oak Ridge National Lab., Tenn.), from report CEA-N–571. 20p. Dep. mn. CFSTI $3.00 cy, $0.65 mn. JCL $1.60 fs, $0.80 mf.

Gamma absorption and attenuation coefficients and fast-neutron displacement cross sections are tabulated for 8 compounds, 12 elements, 7 different types of concrete, and air. (D.C.W.)

23627 CRITICAL HEAT FLUX WITH ORGANIC COOLANTS. Cumo, M.; Palmieri, A. (CNEN, Casaccia, Italy). Termotecnica (Milan), 20: 657-67(1966). (In Italian).

The BORO loop is designed for the determination of the critical thermal flux in subcooled boiling with forced circulation in tubular geometry. The design of this circuit is given and the factors affecting the critical thermal flux are outlined. Two series of tests using test sections of different diameters were made with o-terphenyl as the coolant. The experimental results are tabulated and compared with the theoretical data. (J.S.R.)

23628 UP-TO-DATE CALCULATION METHODS IN REACTOR PHYSICS AND ENGINEERING. Vertes, Peter. Energ. Atomtech., 20: 137-41(Mar. 1967). (In Hungarian).

The classical semiempirical reactor calculation methods are compared with the up-to-date synthetic multigroup techniques. The inadequacy of the former is shown. The theoretical and practical importance of the modern methods and the restrictions as well as the main error sources are discussed. Main characteristics of these methods are briefly pointed out and one of the simplest methods, the P_1 multigroup finite-difference method is described for illustration. Finally some reactor codes are outlined. (auth)

23629 ECONOMIC AND TECHNICAL PROBLEMS CONCERNED WITH THE COOPERATION AMONG N.A.T.O. COUNTRIES IN NUCLEAR ENTERPRISES FOR PEACE. PART II. Di Loreto, Angelo (Univ., Rome). Riv. Ing. Nucl., 4: 1027-48 (Mar.-Apr. 1966).

A review of activities directed toward peaceful uses of atomic energy in the UK is presented. Information on UKAEA establishments and their organization and activities involving reactors, accelerators, and controlled thermonuclear research is included. A brief review of the functions and duties of the USAEC is also included. (J.R.D.)

23630 TWO-DETECTOR CROSSCORRELATION EXPERIMENT FOR THE DETERMINATION OF REACTOR PARAMETERS FROM NEUTRON NOISE. Seifritz, Walter; Stegemann, Dieter (Kernforschungszentrum, Karlsruhe, Ger.). Nukleonik, 9: 169-79(Mar. 1967). (In German).

Crosspower and autopower spectral density measurements have been performed in the externally unperturbed zero power reactors STARK (Fast-Thermal Argonaut Reactor Karlsruhe) and SUR 100 (Siemens-Unterrichtsreaktor 100) using the frequency analysis of noise technique. The specific feature of the two-detector crosscorrelation experiment is the elimination of the uncorrelated noise contribution in the output signal. This was demonstrated experimentally, and the resulting advantages were analyzed. The ratio of correlated to uncorrelated detector events was chosen as a criterion for comparing cross- and autopower spectral density measurements. The ratio is proportional to the detector efficiency and was changed systematically during the program. It was found that the ratio must be at least 2 for the single-detector experiment, whereas for the two-detector experiment the ratio can be reduced to 0.1. This is particularly important if only low detector efficiency is available. An expression is given for the relative mean standard deviation of the crosspower spectral density. It relates the standard deviation with the ratio of correlated to uncorrelated detector events, the bandwidth and the sampling time. In addition, the applicability of an on-line reactivity-meter based on the two-detector crosscorrelation technique is discussed. In this connection results of a parametric study concerning the accuracy achievable in fast and thermal reactor systems are given. An optical correlation demonstrator is described which can be used to determine the correlation coefficient quickly. (auth)

23631 ASYMPTOTIC STABILITY OF A COUPLED REACTOR WITH LINEAR POWER FEEDBACK. Schwalm, D. (EURATOM, Ispra, Italy). Nukleonik, 9: 194-200(Mar. 1967).

Since the kinetic equations of a coupled reactor have only a limited range of validity, the asymptotic stability is studied in a finite closed region around the power equilibrium state. It is necessary to distinguish between the domains of asymptotic stability with respect to the parameters and to the initial conditions. A Liapunov function V is chosen in such a form that the region of asymptotic stability in the parameter space is given by the Hurwitz condition. This Liapunov function is applied to the non-linear dynamic equations. The resulting time derivative $\dot{V}$ is no longer negative definite in the whole state space. The largest V(x) = const. surface which is contained in the region where dV/dt is negative, represents the region of asymptotic stability in the state space. The method is illustrated for the case of two dimensions, i.e., the feedback reactivity in each core is considered as a linear function of the power. (auth)

23632 VERIFICATIONS AND TESTS OF NUCLEAR POWER STATION. Cordelle, F. (Electricite de France, Paris). Energ. Nucl. (Paris), 9: 21-7(Jan.-Feb. 1967). (In French).

An overall description of tests conducted at the St. Denis (France) power station to determine the aerothermal characteristics of fuel channels, operating characteristics of heat exchangers, and to estimate the endurance of gates and selectors designed to ensure operational safety is given. Tests carried out in surrounding media, such as CO_2 gas under pressure or Na, enabled enlargement of the knowledge of the physical and chemical characteristics within those surrounding media. (M.L.S.)

23633 PARTICIPATION AVAILABILITY AND CONTROL OF NUCLEAR POWER PLANTS. Colomb, A.; Klaentschi, M. J. (Motor-Columbus AG, Baden, Ger.). Neue Tech., 9: 27-35(Feb. 1967). (In German).

Some of the operating data available for nuclear power stations is given. With these data the actual degree of availability and the load factor for different types of nuclear plants can be established. Furthermore a comparison is made between nuclear and conventional thermal power plants. Finally some data related to the control behaviour of nuclear power stations are discussed and the way to incorporate nuclear stations in the Swiss electricity supply system is sketched. (auth)

23634 THIRD GENERATION OF BREEDER REACTORS. Bump, T. R. Sci. Amer., 216: No. 5, 25-33(May 1967).

A general discussion of present day breeder reactors is given. The emphasis is placed on the evolution of the reactor and on its capabilities. The various characteristics peculiar to a breeder reactor are considered in some detail. (M.L.S.)

23635 DESIGN, CIVIL ENGINEERING, AND CONSULTING SERVICES FOR NUCLEAR POWER PLANTS. Hundt, Dieter (Allgemeine Elektrizitaetsgesellschaft, Frankfurt am Main). At. Strom, 13: 7-11(Jan. 1967). (In German).

Papers read at the Technical Conference No. 10 at the "Nuclex 66", which deal with the overall planning of nuclear power stations are reviewed. (ATSTA)

23636 FUEL HANDLING SYSTEM FOR THE PFR. Rodwell, W.; Campbell, J. C. (United Kingdom Atomic Energy Authority, Risley, Eng.). Nucl. Eng., 12: 367-71(May 1967).

The system which is described is designed to separate the on-load and off-load functions of the plant and to minimize the magnitude and complexity of the off-load operations. A charge machine mounted in the rotating top shield transfers the irradiated fuel from the core to sodium filled buckets in the fuel storage rotor situated outside the reactor jacket, and replaces it with new fuel from the rotor. All other operations are carried out on-load. The fuel is allowed to cool in the rotor, is transferred by flask to the NaK-filled fuel storage cell, and thence, after a further cooling period, to the breakdown and transport preparation stations. Development work is summarized, and mention is also made of the possibility of the use of the reactor for irradiation experiments. (UK)

23637 THE SODIUM PUMPS FOR THE PFR. Bowles, L. F.; Taylor, D. Nucl. Eng., 12: 361-6(May 1967).

The design and development of the primary and secondary pumps are described, and experience is reported in the operation of a prototype 6,000 gpm vertically mounted centrifugal pump. The problems of noise and cavitation, and the possibility of removal of the pump for servicing, are discussed in reference to the hydraulic design. The mechanical design incorporates a vertical shaft, and a rubbing face dynamic seal allows the drive to operate in air. A Na-fed hydrostatic bearing has been developed for the bottom of the shaft. Fixed speed induction motors control the flow, and pony motors are provided to give circulation in case of main drive failure. The production and testing programme is outlined. (UK)

23638 SODIUM TECHNOLOGY AT THE REL. Evans, P. B. F.; Long, W. (United Kingdom Atomic Energy Authority, Risley, Eng.). Nucl. Eng., 12: 356-60(May 1967).

The development projects being undertaken in the Reactor Engineering Laboratories, Risley, are discussed, together with the facilities available, and the present state of Na engineering for the Prototype Fast Reactor. The fields of development studied in the 12 rigs employed include valves, seals, fuel elements, friction and wear, heat transfer, and instrumentation. (UK)

23639 CONSTRUCTION WORK FOR THE PFR. Williams, K. W. (Taylor Woodrow, Ltd., Whetstone, Eng.). Nucl. Eng., 12: 371-2(May 1967).

The work described includes foundations and superstructure of the main power house complex, (120 ft high by 615 ft long by 150 ft wide), a circulatory water pump house, and a sea wall together with cooling intake and outfall culverts. Problems of organization and supply of materials are discussed, and the present state of the work is reported. (UK)

23640 TOWARDS CHEAPER NUCLEAR POWER STATIONS. Duncton, P. J. (Fairey Engineering Ltd., Stockport, Eng.). Neue Tech., 9: 18-21(Feb. 1967).

A general review of nuclear power plants in operation is given. Emphasis is placed on the discussion of economics of reactors for power production. (M.L.S.)

23641 HERE'S HOW UNCLE SAM TRAINS OPERATORS FOR ITS NUCLEAR POWER PLANTS. Cruse, T. Jr. (Dept. of Army, Fort Belvoir, Va.). Power, 111: No. 4, 81-3(Apr. 1967).

The training program conducted by the Army is described. Aspects of personnel selection are discussed and the 15-week academic phase covering subjects such as mathematics, physics, reactor engineering, mechanical engineering, and health physics is summarized. Information is also included on simulator training and plant training. (J.R.D.)

23642 SOME CONJECTURES ON THE TIME DECAY CONSTANTS IN PULSED MULTIPLYING ASSEMBLIES. Williams, M. M. R. (London Univ.). Nukleonik, 9: 223-7(Mar. 1967).

The discrete time eigenvalues of the Boltzmann equation for a multiplying medium have been studied. On the assumption of non-negative delayed neutron modes, and reality of the eigenvalues, it is found that the prompt decay in a subcritical system is bounded by $(\nu\Sigma)_{min}$ and ceases to exist when the buckling exceeds a certain value. In addition to the prompt decay, there exist six other decaying modes, not directly connected with the thermalization process, which arise from the presence of delayed neutrons. It is shown that the time eigenvalues of these modes are bounded by the corresponding delayed neutron precursor decay constant and that they continue to exist, no matter how large the buckling. Some quantitative results are obtained for a one-velocity model, and for a model which includes the effects of slowing down. It is observed that the maximum buckling value depends on the slowing down length, and hence on the slowing down model. (auth)

23643 NEW BOILING SALT FAST BREEDER REACTOR CONCEPTS. Taube, M.; Mielcarski, M.; Poturaj-Gutniak, S.; Kowalew, A. (Inst. of Nuclear Research, Warsaw). Nucl. Eng. Design, 5: 109-12(Mar. 1967).

Concepts of fast breeder reactors fueled with fused chlorides of U, Pu, with Na and/or K diluent and cooled directly with boiling coolant are discussed including the SAWA reactor boiling homogeneously with $AlCl_3$ as coolant, and the WARS reactor boiling heterogeneously with Hg as coolant. Preliminary calculations for 1000 MWt reactors of both types were performed. The characteristics considered are: SAWA concept: 6000-l core, 0.33 MW/l, cooled with 1340 kg of $AlCl_3$ per second; WARS concept: 10,500-l core, 0.40 MW/l, cooled with 3300 kg of Hg per second. (auth)

23644 COOLING CONCEPTS FOR A COMPACT MOSEL (MOLTEN SALT) REACTOR. Gat, Uri (Kernforschungsanlage, Juelich, Ger. Landes Nordrhein-Westfalen, Juelich, Ger.). Nucl. Eng. Design, 5: 113-22(Mar. 1967).

A review of several engineering possibilities of the Molten Salt Experimental (MOSEL) reactor is given. Internal versus external cooling is compared. Direct contact and conventional heat exchange are discussed. Advantages and disadvantages of the various solutions are indicated. Principal unsolved problems are shown. Design solutions of the direct contact concept are discussed. (auth)

23645 PROBLEM OF THERMAL ANALYSIS OF THE CORE OF A STEAM-COOLED PRESSURE-TUBE POWER REACTOR.

Lys, Leo A. (Eidgenoessisches Institut fuer Reaktorforschung, Wuerenlingen, Switzerland). Nucl. Eng. Design, 5: 123-33(Mar. 1967). (In German).

Thermal analysis problems and the manner in which they were solved within the framework of a conceptual design study for a steam cooled pressure-tube power reactor are discussed. Correlations for determining the heat transfer in a fuel channel, together with the measurements performed to determine them, are described. The procedure used for calculating the average mass flow rate of the coolant per fuel channel and the number of channels is also given. (auth)

23646 NUCLEAR RESEARCH STATION AT GROSSWELZHEIM-KAHL. Kuehnel, Roland (Allgemeine Elektrizitaetsgesellschaft, Frankfurt am Main). At. Strom, 13: 1-7(Jan. 1967). (In German).

The Kahl experimental nuclear power station (VAK), the hot steam reactor at Grosswelzheim (HDR), the nuclear energy test station at Grosswelzheim, and the Kernreaktorteile GmbH (KRT) (nuclear reactor component company) are described. (ATSTA)

23647 ARRANGEMENT OF COOLING WATER RECIRCULATION PUMPS IN INTERIOR OF PRESSURE VESSEL OF BOILING WATER REACTORS. Traube, K. (Allgemeine Elektricitaets-Gesellschaft, Frankfurt am Main). Nucl. Eng. Design, 5: 161-76 (Mar. 1967). (In German).

A version of a boiling water reactor is proposed with coolant recirculation pumps installed within the reactor pressure vessel, thus abolishing external recirculation loops and allowing a more compact design of reactor containment. A review of the development of coolant recirculation systems for boiling water reactors is presented. The design of the proposed internal pumps and the number of such pumps varies proportional with reactor power, each pump handling the flow roughly corresponding to 85 MWe. The effect of the pump system on other parts of the nuclear steam supply system are described. Analysis of the effects of the pump system on reactor availability shows that the internal pump system should improve reactor availability. The described pump system is compared with the jet pump recirculation system. Apart from an important saving of plant capital cost and of reduced pumping power, the system also offers advantages in the areas of reactor control and safety. (J.R.D.)

23648 PERFORMANCE OF INSULATION FOR PRESTRESSED CONCRETE PRESSURE VESSELS FOR BOILING HEAVY WATER REACTORS. Ringstad, B.; Skinstad, A. (Aktiebolaget Atomenergi, Stockholm). Nucl. Eng. Design, 5: 177-82(Mar. 1967).

The insulation selected for the Swedish development of prestressed concrete pressure vessels for boiling heavy water reactors is of the metal foil stagnant gas space type, using a water lock for self-equilibrating the pressures between the steam and gas spaces. The design and operational behavior of the insulation system are described with particular consideration to accident conditions. A testing program to ascertain the performance of the insulation under various normal and accident conditions is outlined, and test equipment and measuring technique are described. Preliminary results of the measurements are reported and compared with other reactor vessel insulation tests. (auth)

23649 MAGNETIC FILTER FOR SMALL PARTICLES. Gardini, A.; Perona, G.; Sesini, R. (CISE, Milan). Nucl. Eng. Design, 5: 199-206(Mar. 1967).

One of the problems raised by the development of steam power plants and nuclear reactors is the formation of crud, mostly consisting of magnetite, which is found in suspension in the boiler feedwater. The temperature of 250 to 300°C precludes using resin filters for the direct elimination of these impurities. Therefore a magnetic filter for this task was conceived and partially developed. The large force needed to attract and remove crud particles flowing with the liquid is obtained by means of ferromagnetic pins placed axially in a uniform magnetic field. The theoretical and experimental results obtained are reported. In addition, design parameters and cost estimates for a 1000 ton per hour system are given. (auth)

23650 SHOULD THE FUEL LOADING MECHANISM BE INSIDE OR OUTSIDE THE REACTOR? Franco, Cesari. Riv. Ing. Nucl., 4: 1015-24(Mar.-Apr. 1966). (In Italian).

Aspects of loading and unloading mechanisms are examined and the reasons for the selection of a system outside the pressure vessel for a low temperature organic cooled reactor are given. The fuel cycle for the low temperature organic cooled reactor are reviewed briefly. The mechanism developed for this particular reactor, partially original and partially typical of fuel loading apparatus, can be used in those reactors in which the coolants are characterized by toxicity. (tr-auth)

23651 ECONOMIC LIFE OF GENERATING STATIONS. Margen, P. H. (Aktiebolaget Atomenergi, Stockholm). Nucl. Eng., 12: 196-8(Mar. 1967).

The physical, economic, and "book life" of generating stations are defined and their significance in the comparison of different types of generating stations is discussed. It is suggested that the economic life is an inverse function of fuelling cost and will be high for nuclear stations. Methods of calculation are proposed and examples for water reactor stations are used to show the principles involved. (INIS-UK)

23652 OUTLINES OF THE CIRENE PROGRAM. Silvestri, M. (CISE, Milan). Energ. Nucl. (Milan), 14: 137-50(Mar. 1967).

The main aspects of the CIRENE program are outlined. A description of the research and development work that has gone into the project is given. The economics of a program such as CIRENE are discussed. (M.L.S.)

23653 QUALITY ASSURANCE AS A MATTER OF PUBLIC POLICY IN THE SAFETY OF ATOMIC POWER PLANTS. Ramey, James T. (Atomic Energy Commission, Washington, D. C.). Nucl. Energy, 45-50(Mar.-Apr. 1967).

The history of the Commission's safety program and licensing procedure is reviewed. The roles of the Commission and industry are discussed in relation to the development of and adherence to standards appropriate to the safe design, construction, and operation of nuclear power plants. (UK)

23654 TRANSPORTATION OF IRRADIATED FUEL FROM THE LATINA ELECTRONUCLEAR POWER PLANT. Kavanagh, M. T.; Gualtieri, G. Riv. Ing. Nucl., 3: 851-9(Sept.-Dec. 1965). (In Italian).

Transportation of the first irradiated fuel from the Latina electronuclear power plant to the Windscale processing plant is described. The design and testing of the container for irradiated fuel and the technical considerations in the transportation are discussed. The trucking, rail, and shipping modifications for the transportation are indicated. Emergency precautions are given. (J.S.R.)

23655 NUCLEAR POWER: TWO YEARS AFTER GENEVA. Seaborg, Glen T. (Atomic Energy Commission, Washington, D. C.). Nucl. Energy, 16-25(Jan.-Feb. 1967).

A review is made of the world energy needs and resources, the current status of reactor technology, and the future development of more advanced nuclear power reactors. Growth of world population and energy consumption are estimated to the year 2000, and a review is made of national nuclear power programmes. Costs are compared for the current light-water, AGR, and Candu-type plants, and for projected near breeder and breeder reactor plants. Uranium resources and requirements are reviewed. (UK)

23656 SPACE-DEPENDENT BEHAVIOR OF A BOILING WATER REACTOR BY AN ADIABATIC MODEL. Nishihara, Hideaki (Kyoto Univ.). J. Nucl. Sci. Technol. (Tokyo), 3: 528-33(Dec. 1966).

In a companion paper an analytical model was developed for space-dependent boiling water reactor kinetics by method of conventional adiabatic approximation. In this paper, some numerical simulations were performed for a sample boiling water reactor of 200 MW(t), together with an analysis of its space-time behavior. The external perturbations applied to the reactor were a step increase in reactivity of 90 cents, sinusoidal variations in reactivity with an amplitude of 10 cents, and sinusoidal variation in vertical acceleration with an amplitude of 0.5 g. Results of the simulation study indicate that space dependence is significant when the reactor is undergoing a large transient, while for small disturbances the reactor behaves with little nuclear space dependence. The latter fact agrees with experimental results on existing boiling water reactors. (auth)

23657 SODIUM-COOLED 1,000 MWe FAST BREEDER REACTOR DESIGN STUDY (1ST CYCLE). Nozawa, Masao. Nippon Genshiryoku Gakkaishi, 9: 16-24(Jan. 1967). (In Japanese).

A design study undertaken on a 1,000 MW(e) sodium-cooled fast reactor is summarized. The conditions adopted as the design targets were good breeding ratio in the reactor core, small positive reactivity of Na void in the central channel of the core, two-zoned power flattening by optimizing the core material composition, and reasonable maximum clad temperature for cladding. PuO_2-UO_2 mixed oxide was chosen as fuel material. A rotating core concept was considered for refueling. A total breeding ratio of 1.44 was obtained. A doubling time of about 9 years is possible with this design. A rough estimate of power cost gives a value of 1.48 yen/kWh. (tr-auth)

23658 THE PERSPECTIVES OF THE DEVELOPMENT OF NUCLEAR POWER IN CSSR. PART ONE. SOME ASPECTS OF

WORLD NUCLEAR POWER. Dosoudil, Frantisek; Tluchor, Zdenek. Jad. Energ., 12: 401-13(Nov. 1966). (In Czech).

Selected passages from the study on the perspectives of the development of nuclear power in the CSSR are presented. This study was approved by the government of the CSSR in August. The aim of the study was to give reason for the direction of the development of nuclear power in this country and give the necessary foundations for the decision of building the second power station A-2 in the period of the fourth five-year plan. The final part of the study contains the necessary data concerning the station A-2. The study is a result of the work of a number of Czechoslovak specialists in the field of nuclear energy and followed several projects of research institutes, industry, and authorities. The first part contains some data of the world development of nuclear power which were used for this study. (auth)

23659 REACTOR TECHNOLOGY PROGRAMS. pp 225-324 of Fundamental Nuclear Energy Research, 1966. Washington, D. C., Atomic Energy Commission, 1966.

A broadly based research and exploratory development program applicable to the technology of many different reactor systems is described. Brief descriptions are presented concerning research on reactor fuels and materials, reactor physics, direct energy conversion, reactor instrumentation, fluid dynamics, and heat transfer, nuclear safety, and radioactive waste management. (J.R.D.)

23660 BOILING WATER REACTOR. Elliott, Vorras A. (General Electric Co., San Jose, Calif.). Mech. Eng., 89: No. 1, 19-26(Jan. 1967).

A summary of boiling water reactors which are operating, under construction, designed, or planned is given. Various aspects of this general class are given. Similarities and differences are discussed. (M.L.S.)

23661 POWER OSCILLATIONS AND THE DESCRIBING FUNCTION IN REACTORS WITH LINEAR FEEDBACK. Akcasu, A. Ziya; Shotkin, Louis M. (Brookhaven National Lab., Upton, N. Y.). Nucl. Sci. Eng., 28: 72-81(Apr. 1967).

The bounded periodic behavior of the reactor power is studied for those instances when the equilibrium power is greater than the critical power level. Simple formulas are derived, for reactors with arbitrary linear feedback and no delayed neutrons, for the amplitude and frequency of the limit cycles. These quantities are shown to be related to the ratio of the equilibrium-to-critical power level and to the Laplace transform of the feedback kernel. Since the techniques used apply for arbitrary values of the fundamental component of the power oscillation, they are used to derive a describing function which is valid for large amplitude disturbances. Conditions for the existence of critical power levels and, hence, limit cycles are discussed. Formulae for investigating the stability of these limit cycles are also derived. Applications are made to the circulating fuel reactor and to the two-temperature reactor. It is also suggested that the results can be used in two practical situations: (1) When the oscillation amplitude is indistinguishable from the reactor noise, the power level can exceed critical; and (2) When the oscillation amplitude is large, the reactor can be used as a self-sustained pulse-modulated neutron source. (auth)

23662 USE OF HYDRAULIC MODELS IN NUCLEAR REACTOR DESIGN. Hetsroni, G. (Westinghouse Atomic Power Div., Pittsburgh). Contract AT(30-1)-3269. Nucl. Sci. Eng., 28: 1-11(Apr. 1967).

Measurements were made of the effect of various internal geometries on the flow distribution at the core inlet and on the Euler numbers in pressurized-water reactors. Attention was focused on the relationship between the flow distribution and the length of the flow skirt, the length of the lower plenum and the layout of instrumentation tubes. The design of these components was optimized. Flow distributions in the annuli formed by the thermal shield and in the lower plenum were determined analytically and confirmed experimentally. (auth)

23663 APPLICATION OF A HYBRID COMPUTER TO THE ANALYSIS OF TRANSIENT PHENOMENA IN A FAST REACTOR CORE. Sanathanan, C. K.; Carter, J. C.; Bryant, L. T.; Amiot, L. W. (Argonne National Lab., Ill.). Nucl. Sci. Eng., 28: 82-92 (Apr. 1967).

The use of a hybrid computer results in an efficient method of analyzing the transience in high-performance nuclear reactor cores using ceramic fuels such as UO_2. The nature of the space dependence of the variables is such that a great deal of multiplexing of computer components is possible. As a consequence of multiplexing, an iterative procedure is necessary to obtain the closed-loop system response for a finite (but arbitrary) interval of time. A mathematical proof of the uniform convergence of the iterative process had been obtained. This proof is based on the principle of contraction mapping. The economy which may be realized in computer equipment and programming effort for this area of system analysis is discussed with illustrative examples. The computing techniques developed are applicable to the analysis of any nonlinear feedback control system. (auth)

23664 FURTHER COMMENT ON THE OPTIMAL SHUTDOWN CONTROL. Nucl. Sci. Eng., 28: 155-7(Apr. 1967).

Brief comments pertaining to optimal shutdown control of reactors are presented. A proof of minimax and time optimal trajectories is given. (M.L.S.)

23665 STEAM GENERATING HEAVY WATER REACTOR. Cartwright, H. Atoomenergie Haar Toepass., 9: 18-21(Jan. 1967). (TRG-Report-1246).

The Steam Generating Heavy Water Reactor (SGHWR) is a direct-cycle, boiling light-water reactor of pressure-tube design, moderated partly by heavy water and partly by the light-water coolant. The pressure-tube design permits extrapolation of the present 100 MW(e) design to larger sizes, without introducing new technical problems, simply by increasing the number of tubes while retaining the same fuel element. Cost per unit of electricity produced from any nuclear power station depends on the site selected, the customer's requirements and other variables; certain features of reactor systems can be recognized as fundamentally desirable and likely to lead to low costs with a high degree of safety. These are presented for the SGHWR. (auth)

23666 HYDRAULIC CHARACTERISTICS OF A NATURALLY CIRCULATING BOILING WATER SYSTEM. Spigt, C. L. Atoomenergie Haar Toepass., 9: 1-18(Jan. 1967).

A review is given of the various types of flow oscillations which can occur in steam-water mixtures. Results are given of a systematic experimental study on the steady-state characteristics and the onset and character of a common type of oscillations, which are caused by the interaction between the steam production and the recirculation rate. It is shown that there is a connection between the stability characteristics of the steady-state and the onset of flow oscillations in a two-phase mixture. The burn-out heat fluxes are presented and obtained in transient conditions. The experimental results are compared with those obtained from a theoretical study. (auth)

23667 A CONSTRUCTION PLANNING FOR ATOMIC POWER STATIONS. I. THREE-ZONE PLANNING. Shimizu, Yasuichi (Fuji Electric Mfg. Co., Ltd., Japan). Nippon Kenchiku Gakkai Ronbun Hokoku-shu, 497(Sept. 1965). (In Japanese).

The reactor complex involves three areas. These areas include the area devoid of any radiations, the area with radiations, and the area having contaminated substances as a result of their irradiation by liquids or solids in the second area. Descriptions and construction plans are given for dual and reversible uses of the areas. (NSA of Japan)

23668 DEVELOPMENT OF A MAGNETIC JACK TYPE CONTROL ROD DRIVE MECHANISM FOR POWER REACTORS. Kishida, Koji; Ono, Akira (Mitsubishi Electric Mfg. Co., Ltd., Japan). Mitsubishi Denki Giho, 40: 1791-7(Nov. 1966). (In Japanese).

A Magnetic Jack Control Rod Drive Mechanism of a latch type has prominent features of reliable operation, stable characteristics over a long range, and perfect seal against high pressure coolant of the pressurized water reactor system. The materials and the manufacturing techniques of the mechanism were developed, the device was completed, and examinations were carried out to check the optimum sequence, scram characteristics and heat dissipation. After ascertainment of the characteristics of the mechanism, the life test was conducted under high temperature and high pressure simulated to those of the reactor, so as to confirm the practicability of the apparatus. (NSA of Japan)

23669 SAFETY STANDARD FOR DESIGN, FABRICATION, AND MAINTENANCE OF STEEL CONTAINMENT STRUCTURES FOR STATIONARY NUCLEAR POWER REACTORS. ASA N6.2-1965. New York, American Society of Mechanical Engineers, 1965. 13p.

Minimum requirements and their applications are presented for a reactor vessel containment structure. The design of the containment vessel and the plant location must be adapted to each reactor type. (J.C.W.)

23670 IMPROVEMENTS IN OR RELATING ACTUATORS FOR NUCLEAR REACTOR CONTROL. Challender, Ronald Scott; Pugh, Michael Charles; White, William Paul (to United Kingdom Atomic Energy Authority). British Patent 1,066,014. Apr. 19, 1967. Filed Dec. 2, 1963.

An actuator designed to cause fast or slow control rod insertion into the core and to ensure controlled withdrawal of the control rod is described. Drawings are included. (J.R.D.)

23671 COUPLED REACTORS. (to Atomic Energy of Canada, Ltd.). British Patent 1,066,010. Apr. 19, 1967. Priority date Feb. 24, 1965, Canada.

A method of operating two or more reactors so that the neutron leakage from one of the reactors may be used to burn the xenon poison from an adjacent one is described. (J.R.D.)

23672 CONTROL OF COOLANT PURITY IN SODIUM-COOLED REACTORS. Simons, E. M.; Basham, S. J. (Battelle Memorial Inst., Columbus, Ohio). New York, American Society of Mechanical Engineers, 1966, Preprint No. 66-WA/NE-17, 15p., $1.50. (CONF-661102-8). DTIE.

From American Society of Mechanical Engineers, Winter Annual Conference, New York.

A general survey of the existing knowledge of the effects, detection, and control of impurities in Na coolant systems in reactors is given. Discussions of the effects on impurities on heat transfer characteristics, methods of in-line Na impurity monitoring, methods of chemical analysis, and impurity control devices are presented. A useful list of references of work on sodium technology is also included. (M.L.S.)

23673 PRESSURE REGULATOR FOR NUCLEAR REACTORS. Plante, J. (to CEA). Canadian Patent 750,022. Jan. 3, 1967. Priority date Sept. 26, 1962, France.

Reactor control is achieved by variation of pressure of a gaseous mixture consisting of a neutron absorbing gas and an inert gas such as ^{3}He. This mixture is held in vessels in the reactor core or in the reflector. The reactivity is controlled by a pump and a pressure reducing valve. The design of apparatus for regulating the pressure of the absorbent gas mixture in a closed circulation loop is the object of the device. Rapid response is claimed. (F.S.A.)

23674 IMPROVEMENTS IN NUCLEAR REACTORS AND A METHOD OF OPERATING SAME. (to Babcock and Wilcox Co.). British Patent 1,061,274. Mar. 8, 1967. Priority date Feb. 28, 1963, United States.

A design is given for a fast heavy water–light water steam-mixture cooled reactor having a negative coefficient of reactivity. Control of the reactor is effected by use of a compressible moderating fluid, the variation of which directly affects the reactivity of the reactor. (M.L.S.)

23675 METHOD AND APPARATUS FOR INCREASING THE CRITICAL HEAT FLUX FOR HIGH PRESSURE STEAM–WATER FLOW IN NUCLEAR REACTORS. (to Atomic Energy of Canada, Ltd.). British Patent 1,061,878. Mar. 15, 1967. Priority date Aug. 31, 1964, Canada.

A design is given for an apparatus which increases the critical heat flux for pressurized boiling water reactors. The design comprises a series of roughness rings attached to the inner surface of the coolant channels of the fuel. (M.L.S.)

23676 NUCLEAR REACTOR. (to Hitachi Ltd.). British Patent 1,063,310. Mar. 30, 1967. Priority date Dec. 27, 1962, Japan.

A design is given for a fast-thermal reactor. The fast part of the core and the thermal part of the core are each contained in separate pressure vessels; these are then combined to form an integral core. (M.L.S.)

23677 SAFETY DEVICE FOR A HEAT EXCHANGE SYSTEM. (to CNEN). British Patent 1,064,273. Apr. 5, 1967. Priority date Feb. 6, 1963, Italy.

A design for a safety device for a heat exchange system, comprised of the primary and secondary loops, is given. An expansion vessel is connected to the primary loop, a drain tank connected to the primary loop by way of a valve, a vent connecting the secondary loop to the atmosphere, and a pressure sensor in the primary loop serve to keep the primary loop pressures at lower than design values. (M.L.S.)

23678 HIGH TEMPERATURE NUCLEAR REACTOR. (to General Dynamics Corp.). French Patent 1,421,433. Nov. 8, 1965. Priority date Oct. 31, 1963, United States.

The safety of a reactor is improved by distributing the absorber material so as to increase the overall negative coefficient of reactivity. For this purpose a non-1/V. absorber material, such as ^{103}Rh, ^{167}Er and ^{240}Pu responding to changes in the moderator temperature are placed at the hotter parts of the reactor, while resonance absorbers, preferably fertile materials, such as ^{232}Th and ^{238}U are placed at the cooler parts of the reactor. For the sake of safety of a high temperature nuclear reactor, the reactivity should change promptly with temperature. Since the Doppler effect in the fertile material depends directly on the temperature of the fertile material itself, the prompt response is obtained by intimately mixing the fertile material with the fuel material in the fuel compact. The reactivity contribution from the non-1/V materials, however, is determined by the average temperature of the moderator material which determines the spectrum of thermal neutron energies. (I.I.B.)

23679 STEAM COOLED NUCLEAR REACTOR. (to Babcock and Wilcox Co.). French Patent 1,405,490. May 31, 1965. Priority date June 18, 1963, United States.

The reactor is variably controlled and moderated by introducing a single phase hydrogen-isotope-bearing moderating fluid capable of a substantial change in density with a change in enthalpy into the core. The reaction is regulated by varying the concentration of the moderating fluid within the core and by varying the mixture of fluids having different moderating power. (I.I.B.)

23680 LARGE FAST NUCLEAR REACTOR. (to United States Atomic Energy Commission). French Patent 1,404,791. May 24, 1965. Priority date Oct. 16, 1963, United States.

A large direct-cycle, light-water cooled, supercritical pressure power reactor operates predominantly on fast neutrons. The reactor incorporates Pu-239 as fuel and develops 300 MW(e) power. The reactor core incorporates a plurality of fissionable fast active regions separated by a layer of moderating material at the center of two layers of fertile material. The moderating layer degrades the energy of neutrons leaking out of the fast core regions. Because of their lower energy, a large fraction of these leakage neutrons is absorbed in the fertile material, which has a relatively high intermediate and thermal energy neutron capture cross section, and is thereby prevented from interacting with adjacent fast regions. The increased fast leakage as a result of coolant loss is sufficiently high to counteract the positive components of the coolant void reactivity coefficient. (I.I.B.)

23681 NUCLEAR REACTOR. (to Nuclear Power Plant Co., Ltd. A.E.I.-John Thompson Nuclear Energy Co. Ltd.). French Patent 1,417,593. Oct. 4, 1965. Priority date Jan. 23, 1964, Great Britain.

A concrete pressure vessel encloses the core of the reactor and has heat exchangers disposed around the core. Instruments for the measurement of neutron flux are located in the bottom wall of the vessel, which has a passage therein extending from one of the sides of the vessel to permit the access to the instruments. The passage is provided with a secondary radiation shield. (I.I.B.)

23682 INTEGRAL BOILER NUCLEAR REACTORS. (to Babcock and Wilcox Co.). French Patent 1,382,121. Nov. 9, 1964. Priority date July 31, 1962, United States.

The compact reactor system incorporates the reactor, the heat exchanger, the associated vapor-liquid separating equipment and the pressurizer within one vessel, wherein vapor generating as well as vapor super-heating can be accomplished. An arrangement is provided wherein decay heat can be removed after the reactor has been shutdown. (I.I.B.)

23683 PLANT FOR THE GENERATION OF SELF-MAINTAINING NUCLEAR FISSION REACTIONS BY MEANS OF NEUTRONS. (to Reactor Centrum Nederland). French Patent 1,383,478. Nov. 16, 1964. Priority date Feb. 26, 1963, Netherlands.

The plant comprises a reactor system formed by a group of individual reactors and accessories, each of which is surrounded by its own double walled envelope, that is by a shield and a gas-tight second envelope. In each reactor the space confined is connected to the gas-holder by an individual passage. A return shock safeguarding device is provided in each of the passages which prevents the radio-active gases, vapours or solid particles released in one of the reactors due to an excursion or a rupture of a conduit from reaching the envelopes of the other reactors. (I.I.B.)

23684 IMPROVEMENTS IN NUCLEAR REACTORS. (to Nuclear Power Plant Co. Ltd. A.E.I.-John Thompson Nuclear Energy Co. Ltd.). French Patent 1,389,916. Jan. 11, 1965. Priority date Apr. 8, 1963 and Mar. 11, 1964, Great Britain.

The nuclear fuel of the reactor is located in bores in a neutron moderating core. The core is enclosed in a vessel through which standpipes pass to permit access to the inside of the vessel, wherein tubular members extend from the standpipes. Some of the tubular members have a number of extensions branching off therefrom, while each extension extends into a fuel channel in the core. Plugs are inserted in each of the extensions at the place where they branch off from the tubular member. The plugs are so shaped that any one plug can be removed while leaving the remainder in position, and the passage so formed is such as to permit fuel to pass from the standpipe into the tubular extension from which the plug has been removed and thence into a fuel channel. (I.I.B.)

23685 NUCLEAR REACTORS USING A LIQUID MODERATOR. (to United Kingdom Atomic Energy Authority). French Patent 1,431,285. Jan. 31, 1966. Priority date Mar. 20, 1964, Great Britain.

The core of the reactor consists of two interlaceable parts. The second part is adjustable between two positions relative to the first part: A first subcritical position with the second part in interlaced relationship with the first part, so that the ratio of moderator to fuel in the core results in the reactor being maintained in a subcritical state. The second, critical position with the second part at least partially withdrawn from the first part to allow moderator to be situated there between so that the ratio of moderator to fuel in the core maintains the reactor in a critical state. (I.I.B.)

23686 REACTOR PERIOD METER. Yamamoto, Hisashi (to Hitachi, Ltd.). Japanese Patent 1966-9119. May 14, 1966. Filed July 2, 1962.

A period meter for reactor control is the most important control device. The design consists of the device for detecting a quantity corresponding to the period, the device for detecting a quantity corresponding to the log $\phi(t)$ at this period, and the circuit which combines the outputs of the two detectors so that the increment of the period T and of the neutron flux level $\phi(t)$ act in the opposite ways with regard to the combined value. By means of this combined output, the desired indication and reactor control are achieved. (NSA of Japan)

23687 NUCLEAR REACTOR. Hayashi, Tsutomu (to Hitachi, Ltd.). Japanese Patent 1966-9120. May 14, 1966. Filed May 8, 1963.

In the boiling water-type reactor, the retention of core steam produced from the fuel elements is prevented. In parallel with a horizontal pipe in which a fuel rod is contained is located a pipe which penetrates the reactor vessel wall at both ends. Each end of the pipe connects to the vapor separator outside the reactor vessel. The two pipes connect to each other through many passages, the coolant water enters the fuel pipe at the lower side. The reactor core is arranged in this combination of pipes one above the other. (NSA of Japan)

23688 NUCLEAR REACTOR. Yasujima, Kenryo (to Hitachi, Ltd.). Japanese Patent 1966-6798. Apr. 6, 1966. Filed Apr. 12, 1963.

The design of improved supports for a reactor core is described. At the bottom of the pressure vessel in which the reactor core is contained, a cylindrical body is placed vertically in the direction of the pressure vessel axis. The lower half of the cylinder protrudes out of the pressure vessel and the upper half is within the vessel. Through the bottom of the lower half penetrate the holes for passage of the control rod supports. The reactor core is placed in the open upper end of the cylindrical body. (NSA of Japan)

23689 LIGHT-WATER-COOLED NATURAL URANIUM POWER REACTOR. (to Atomic Energy of Canada Ltd.). British Patent 1,063,683. Mar. 30, 1967. Priority date Aug. 31, 1964, Canada.

A boiling water reactor economically feasible is presented. A light-water-cooled natural U boiling water nuclear reactor including one or more pressure tubes extending through the reactor core and each containing fuel is described. (J.C.W.)

23690 IMPROVEMENTS IN OR RELATING TO NUCLEAR REACTOR FUEL ELEMENTS. Edge, Thomas (to United Kingdom Atomic Energy Authority). British Patent 1,063,631. Mar. 30, 1967. Filed Feb. 6, 1964.

A method for the prevention of diffusion of uranium and uranium compounds through the fuel element sheath material during operation is given. A fuel element of U or U-base alloy enclosed in a sheath of a Mg-base cladding-alloy magnox ZR55 (0.5–0.6 wt % Zr, remainder Mg), diffusing through a part of the cross-sectional thickness of the sheath wall forming an intermetallic compound with Pu, serves as a barrier against fuel diffusion through the Pu sheath material. (J.C.W.)

23691 NUCLEAR REACTOR. (to United Kingdom Atomic Energy Authority). French Patent 1,427,298. Dec. 27, 1965. Priority date Feb. 11, 1964, Great Britain.

The core of a nuclear reactor incorporates fuel containing zones and fuel free zones. The fuel containing zones include fissile material and moderator (water) in a proportion consistent with a critical assembly. The fuel free zones are bounded by absorber material with neutron capturing characteristics predominantly in the thermal energy region. Means are provided for introducing moderating material, at will, into the fuel free zones so as to thermalize neutrons to energy levels where they may be absorbed by the absorber material. (UKAEA)

23692 NUCLEAR REACTOR WITH PRESSURE TUBES. (to Sulzer Brothers Ltd.). French Patent 1,425,608. Dec. 13, 1965. Priority date Jan. 28, 1964, Switzerland.

The pressure tube, strong enough to withstand the pressure of the reactor coolant, is provided with an inner tube receiving portions of fissile material. Portions made of a thermally insulating material having reduced neutron absorption (graphite) are placed around the fuel elements. The coolant is supplied at both ends of the pressure tube and flows through pipe connections into the gap between the pressure tube and the inner tube. The inner tube is provided at the center of the reactor core with apertures through which the coolant can flow from the gap into the inner tube and is removed via the fissile material. The temperature of the pressure tube remains therefore relatively low. (UKAEA)

23693 ENERGY PRODUCING NUCLEAR REACTOR. (to United States Atomic Energy Commission). French Patent 1,417,877. Oct. 4, 1965. Priority date Jan. 3, 1964, United States.

A reactor for the direct conversion of thermal to electric energy comprises a plurality of cells, each cell comprising an emitter and a collector being separated and of cylindrical configuration. An easily ionizable gas (Cs) is contained in the space between the emitter and the collector. The collector comprises a container enclosing a condensable Li vapour and capillary means capable of causing the transport of condensed vapour from a cooler area of the container to a hotter area. The collector cylinder is a larger diameter than the emitter cylinder. A reflector ring surrounds the emitter cylinder and is in physical contact with the collector. (IIB)

23694 PULSED FAST REACTOR. (to EURATOM). French Patent 1,428,713. Jan. 10, 1966. Priority date Apr. 14, 1964, Great Britain.

One or more wheels, carrying on its periphery neutron absorbing material, rotates through the reactor core. One or more regions on the wheel are substantially devoid of absorbing material. The reactor is designed to be below critical, when a region with absorbing material is in the core and to be at least promptly critical when a void region devoid of absorbing material is within the core. (UKAEA)

23695 DEVICE FOR REGULATING THE POWER OF A NUCLEAR REACTOR. (to CEA). British Patent 1,064,382. Apr. 5, 1967. Priority date June 25, 1963, France.

A design for a power regulating device for a reactor is given. The device consists of a rod, driven from the bottom, which is positioned in a detachable container in the withdrawn position. (M.L.S.)

23696 LIQUID METAL FAST BREEDER REACTOR. (to U. S. Atomic Energy Commission). British Patent 1,060,999. Mar. 8, 1967. Priority date May 20, 1964, United States.

A design is given for a liquid metal cooled fast breeder reactor. The reactor contains a void region between the core and blanket which is comprised of sealed pockets of inert gaseous materials. The void region serves to reduce the absorption of neutrons passing from the core to the reactive region, thereby producing the desired negative coefficient of reactivity. (M.L.S.)

23697 SAFETY EQUIPMENT FOR NUCLEAR POWER-REACTOR PLANTS. Ziegler, A.; Petersen, G. (to Siemens-Schuckertwerke Aktiengesellschaft). Canadian Patent 749,748. Jan. 3, 1967.

A concrete containment structure encloses a steel structure whose diameter is about 2 meters less. The reactor is contained in the latter and there is a large space having spray heads under the reactor. At the top of the concrete containment a large water tank has several pipes immersed to different depths. These are siphons which convey water to the spray system in the event of rupture of the steam lines. Excess steam pressure ruptures a set of diaphragms to actuate the siphon-spray system. Means are provided to equalize the pressure in the whole containment structure and to avoid local areas of high pressure. The siphon intake pipes are arranged to prolong the spray time. (F.S.A.)

23698 GENIE ATOMIQUE. TOME IV. LES PROPRIETES DES MATERIAUX DES REACTEURS NUCLEAIRES. A. LES MATERIAUX COMBUSTIBLES. B. MATERIAUX DE GAINE ET DE STRUCTURE. VOLUME I. (Atomic Engineering. Volume 4. Properties of Nuclear Reactor Materials. A. Fuel Materials. B. Canning Materials and Their Structure. Volume I). Bibliotheque des Science et Techniques Nucleaires. Saclay, France, Institut National des Sciences et Techniques Nucleaires, 1965. Paris, Presses Universitaires de France, 1965. 716p.

23699 GENIE ATOMIQUE. TOME IV. LES PROPRIETES DES MATERIAUX DES REACTEURS NUCLEAIRES. C. ELEMENTS COMBUSTIBLES DES PILES HETEROGENES. D. LES

MODERATEURS. E. MATERIAUX DE CONTROLE. F. LES REFRIGERANTS. VOLUME II. (Atomic Energineering. IV. Properties of Nuclear Reactor Materials. C. Fuel Elements for Heterogeneous Reactors. D. Moderators. E. Control Materials. F. Coolants. Volume II). Bibliotheque des Science et Techniques Nucleaires. Bibliotheque des Science et Techniques Nucleaires. Saclay, France, Institut National des Sciences et Techniques Nucleaires, 1965. Paris, Presses Universitaires de France, 1965. 689p.

Marine and Portable Power Reactors

Refer also to abstract 23706.

23700 NUCLEAR REACTOR. Keenan, Frank (to United Kingdom Atomic Energy Authority). British Patent 1,063,696. Mar. 30, 1967. Filed Oct. 28, 1963.

Two reactors for marine propulsion are proposed. The invention relates to nuclear reactors having the core and a heat exchanger housed in a single vessel. In these integral reactors it is convenient to locate the core coaxially of the reactor vessel and to provide a control mechanism plenum above the core, reactor control mechanisms and their rods when withdrawn being located in the plenum. Heat exchange units are located in an annular heat exchange plenum which is coaxial with the core and the control mechanism plenum. These heat exchange units comprise inlet and outlet headers and tubular elements connected in parallel between the headers. (J.C.W.)

Rocket and Space Reactors

Refer also to abstracts 22089 and 22203.

23701 (TID-22929) PERFORMANCE CHARACTERISTICS OF ETS-1 NUCLEAR EXHAUST SYSTEM, NERVA PROGRAM. (Aerojet-General Corp., Azusa, Calif.). Oct. 1964. Contract SNP-1. 78p. (RN-S-0099(Rev.)). Dep. mn. CFSTI $3.00 cy, $0.65 mn.

An ejector system for Engine Test Stand-1 (ETS-1) at Nevada Rocket Development Site (NRDS) was selected at the completion of the testing and analysis program of CY 1963. During the CY 1964 program, this selected ejector system was subjected to a series of system performance analysis tests to provide an operational map, as well as a high level of confidence in the prediction of operation of the Nuclear Exhaust System (NES) at NRDS. Ejector system performance analysis tests were first conducted using a $\frac{1}{8}$ scale model system. A $\frac{1}{4}$-scale model ejector system was built and tested to verify the scaling parameters used and, consequently, to increase the confidence level of the performance predications of the full-scale ejector system. The data were analyzed and compared with the $\frac{1}{8}$-scale data. Data agreement was considered to be very good in all areas, therefore, there is high confidence in the prediction of performance and operation of the NES at NRDS. (auth)

23702 SATURN NUCLEAR STAGE SEEN POSSIBLE IN '75. David, Heather M. Technol. Week, 19: 118; 121-3(Nov. 28, 1966).

Tests of two Phoebus reactors and two experimental engines (XE) are to be carried out by 1968. The nuclear third stage for the Saturn V launch vehicle should be flown in 1975. Design analysis and systems analysis are under way on the flight NERVA. Progress has been made with one of the longest-leadtime items — the engine test facility or the Nuclear Rocket Development Station (NRDS) in Nevada. Dynamic tests of the stages would be at NASA's Marshall Space Flight Center, with engine testing done at Jackass Flats, Nevada. Tests must be completed at extending the duration capability, the temperature capability and power density of the reactor, and proving out the flight experimental engine. (J.C.W.)

23703 NUCLEAR POWER IN SPACE. Brunings, J. E.; Johnson, C. E. (Atomics International, Canoga Park, Calif.). Mech. Eng., 89: No. 2, 34-41(Feb. 1967).

A detailed description of the utilization of reactors in conjunction with the thermoelectric power space program is given. Both the SNAP 10A and SNAP 8 systems are discussed. Design data of the SNAP 8 reactor is given. (M.L.S.)

23704 NUCLEAR REACTOR. (to U. S. Atomic Energy Commission). British Patent 1,064,431. Apr. 5, 1967. Priority date Aug. 15, 1963, United States.

A design is presented for a reactor composed of hemispheres of ^{233}U. The hemispheres are moveable, being placed in contact to obtain criticality. Thermoelectric elements are placed throughout the reflector to convert the heat into electric energy. (M.L.S.)

Process Heat and Desalination Reactors

23705 (ORNL-4087) NUCLEAR DESALINATION PROGRAM. Annual Progress Report on Activities Sponsored by the Atomic Energy Commission for Period Ending October 31, 1966. Burwell, C. C. (comp.) (Oak Ridge National Lab., Tenn.). Mar. 1967. Contract W-7405-eng-26. 93p. Dep. mn. CFSTI $3.00 cy, $0.65 mn.

A summary of the work on desalination, which is either completed or in progress, is presented. Economic feasibility and industrial applications of nuclear energy as applied to desalting are discussed. An analysis of the desalting plant system coupling is presented; dual-purpose control studies and large dual-purpose plant siting and safety studies are discussed. Types of reactors with high water-to-power ratios are considered, and a brief discussion of the nuclear desalination information center is given. A list (43) of papers, articles, and reports published from April 1965 to the present is given. (M.L.S.)

23706 SPECIAL APPLICATIONS OF NUCLEAR ENERGY: SHIP PROPULSION, DESALINATION. Taurit, Rudolf (Allgemeine Elektrizitaetsgesellschaft, Frankfurt am Main). At. Strom, 13: 11-14(Jan. 1967). (In German).

Papers read at the Technical Conference No. 11 at the "Nuclex 66", which deal with the ship propulsion and desalination are reviewed. (ATSTA)

23707 BRITISH DEVELOPMENTS IN DUAL PURPOSE DESALINATION PLANTS. S. Afr. Mining Eng. J., 77: 3065-8; 3075(Dec. 23, 1966).

Development of nuclear-powered desalination plants by the U. K. Atomic Energy Authority is discussed, with emphasis on heat requirements and safety features. The specifications of a dual purpose plant and the annual operating costs are given, based on present day technology. The studies described are based on plants consisting of a number of 10-Mgal/day units in parallel. The two reactor systems chosen for the study have two characteristics of importance to dual purpose plant operation: they are capable of on-load refueling, which leads to high availability and high load factors; and they have excellent safety characteristics. Safety studies on reinforced concrete pressure vessels are included. The unit described circumvents the safety problem of a large steel pressure vessel by subdivision of the core into a number of pressure tubes, one per fuel channel; each channel is equipped with emergency spray cooling which has been shown adequate to cope with a pressure tube failure. (BBB)

23708 WATER PRODUCTION USING NUCLEAR ENERGY. Post, Roy G.; Seale, Robert L. (eds.). Tucson, University of Arizona Press, 1966. 404p. $7.50. (CONF-660311).

Reprints of 27 papers given at the conference concerning alternative approaches to water resource development are presented. The papers are grouped in sections on water problems of North America, sociological problems of water production, national saline water program and current desalting technology, impact of new water sources, nuclear reactors for water desalting, and systems for water desalting. (J.R.D.)

Research and Test Reactors and Critical Assemblies

Refer also to abstracts 21938, 22425, and 23589.

23709 (AECL-2651) LATTICE MEASUREMENTS WITH 7-ROD CLUSTERS OF NATURAL URANIUM CARBIDE IN HEAVY WATER MODERATOR. PART II. NEUTRON SPECTRUM PARAMETERS IN A LATTICE CELL. Kay, R. E.; Green, R. E. (Atomic Energy of Canada Ltd., Chalk River (Ontario)). Dec. 1966. 46p. Dep. mn. CFSTI $3.00 cy, $0.65 mn. AECL $1.00.

Experiments have been performed in the ZED-2 critical facility to determine In-Mn and Lu-Mn activity ratios at various positions in the central cell of lattices of seven rod clusters of UC in heavy water moderator. The measurements were made in square lattices at several pitches using different coolant materials. The activity ratios have been interpreted in terms of the Westcott epithermal index r, and effective neutron temperature T_n, and compared with values predicted by the Chalk River lattice recipe code LATREP. (auth)

23710 (BNL-994, pp 45-69) NUCLEAR ENGINEERING. (Brookhaven National Lab., Upton, N. Y.).

Results of fundamental studies in reactor physics, chemistry

and metallurgy are reported. Progress is reported on research concerning high-temperature reactor materials, liquid-metal heat transfer, fission product release, and superconductivity in metals. Progress is also reported on long-range development of reactor fuels, high-temperature fluid-bed fuel processing, use of fluidized beds for water desalination, development of radiation engineering methods, development of waste processing devices, and research on direct conversion. (J.R.D.)

23711 (BNWL-340) REACTOR PHYSICS DEPARTMENT TECHNICAL ACTIVITIES QUARTERLY REPORT, JULY-SEPTEMBER 1966. (Battelle-Northwest, Richland, Wash. Pacific Northwest Lab.). Oct. 15, 1966. Contract AT(45-1)-1830. 72p. CFSTI $3.00 cy, $0.65 mn.

A recent revision in HRG (Hanford Revised Gam), a neutron slowing down code, modifies the calculation of the effective resonance integral of individual resonance by using for normalization an approximation to the flux used in the resonance integral calculation itself rather than a 1/E flux. A calculation study of thermalization within a simple cell has been made using the RBU Monte Carlo, THERMOS, and Program S-XIII codes. A comparison of the results shows the RBU Monte Carlo thermalization routine is formulated correctly and free from detectable numerical error. Experiments have been conducted in the PRCF using 2 wt % PuO_2-UO_2 fuel in H_2O. These experiments are directed towards determining the physics properties of Pu-fueled H_2O moderated reactor systems. Results are given for a two-zone critical experiment. Also given are results of measurements in a single-zone loading of fuel which contains 24 wt % ^{240}Pu. A calculational study of thermalization in PuO_2-UO_2 fueled H_2O moderated lattices has been performed. The purpose of the study is to determine whether errors are incurred in making assumptions pertaining to scattering processes, boundary conditions, and the source of thermal neutrons. Measurements have been made in the PCTR with a mixed lattice of Pu-Al fuel and thoria targets in alternating cells. New techniques were developed to adapt the PCTR type of measurement to this lattice array of supercells. The results include values of k_∞ for the array with and without water coolant surrounding the fuel and targets. Neutron activation of gold foils in the thermal column of the PCTR have been made to measure the relative neutron flux intensities for various thermal column conditions. The addition of a polyethylene reflector to the graphite stack was found to improve the thermal neutron intensity and to reduce the fast neutron component of the total flux. The presence of a small cavity in the center of the thermal column did not appreciably reduce the neutron flux gradient in the standard foil irradiation position. Neutronics calculations were performed for an 800 liter, PuO_2-UO_2 FTR "reference" core. Principal physics statistics and kinetics parameters were determined. To assess the accuracy of the present cross-section set in use for design calculations, numerous critical assembly results have been analyzed. In general, the computed fissile fuel fission ratios are in reasonable agreement with experiment, whereas the computed $^{238}U/^{235}U$ fission ratios are consistently higher than experimental values. A new group cross-section "collapsing algorithm" has been devised which makes use of a pseudo absorption cross section in each coarse group. The use of such "perturbation" cross sections is much more accurate for computing moderator reactivity coefficients than corresponding models using flux weighted sections. The removal-diffusion code MAC has been used to compare four different axial shield arrangements for the FTR. Energy and spatial distributions of both neutron and gamma fluxes have been obtained. Basic shielding requirements for a number of FTR fuel processing and handling facilities have been specified. Subcritical neutron interaction experiments were performed with bare and Plexiglas reflected arrays of bottles containing aqueous solution of ^{233}U. The critical numbers of bottles in arrays were determined for various spacings. In addition, the effects of internal moderation brought about by positioning Lucite sheet in various thicknesses between the bottles comprising several arrays were studied. The concentration of U in the experiments was 330 g ^{233}U/liter. The experiments provide data for nuclear safety guidance in handling, storage, and shipment of the material and for checking interaction calculations. A series of criticality experiments were begun, using a vessel of unique design, for determining bare and reflected critical thicknesses of plutonium solution in slab geometry. The slab vessel was designed to permit adjustment of its thickness over the range 3 to 9 in. Criticality experiments were performed, bare and water reflected, in the thickness range 4.5 to 6.5 in., with $Pu(NO_3)_4$ solution containing ~58 g Pu/liter with an acid molarity of 2.3. Infinite slab thicknesses are estimated from the measurement data. To permit studying the fundamental behavior of neutrons in Pu-fueled systems, critical approach, pulsed neutron source and foil activation measurements were made on three PuO_2-polystyrene-fueled assemblies. (auth)

23712 (BNWL-CC-868) FAST REACTOR LIBRARY FOR USE WITH RIBD. Bunch, W. L.; Marr, D. R. (Battelle-Northwest, Richland, Wash. Pacific Northwest Lab.). Oct. 17, 1966. Contract AT(45-1)-1830. 29p. Dep. mn. CFSTI $3.00 cy, $0.65 mn.

A computer library of fast fission yield factors and fast neutron burnup cross sections which is to be used with the RIBD (Radioisotopes Buildup and Decay) computer program is presented. This enables fast reactor parameters to be calculated with RIBD. (M.L.S.)

23713 (CEA-R-3102) NOTION DE FONCTION DE TRANSFERT POUR UN REACTEUR NUCLEAIRE. (Concept of Transfer Functions for a Nuclear Reactor). Dalfes, Abdi (Commissariat a l'Energie Atomique, Saclay (France). Centre d'Etudes Nucleaires). Dec. 1966. 27p. (In French). Dep. mn.

The solution to the correlation equations are expressed in terms of the eigenvalues and eigenmatrices of the transport operator, for a subcritical zero power reactor. This allows to define, for each point of the reactor and for detectors detecting neutrons of given velocities, correlation and transfer functions driven by the same white-noise source. A precise meaning is also given to the importance operator, which is the adjoint of the transport operator. (auth)

23714 (DP-1076) ZERO-POWER MEASUREMENTS ON A HIGH-FLUX DEMONSTRATION LATTICE. Dunklee, A. E.; Jewell, C. E. (Du Pont de Nemours (E. I.) and Co., Aiken, S. C. Savannah River Lab.). Apr. 1967. Contract AT(07-2)-1. 65p. Dep. mn. CFSTI $3.00 cy, $0.65 mn.

A Savannah River production reactor was loaded with a novel lattice capable of operation at neutron fluxes in excess of 6×10^{15} n/(cm^2) (sec). The high flux was attained by operating a relatively small number of fuel elements at very high specific powers to achieve maximum neutron production and by using a very light lattice to achieve long neutron lifetimes. The reactor control system was modified to compensate for fuel burnup and to provide optimum flux shaping. In preparation for this new loading, experiments were performed in the SRL exponential (SE) and critical (PDP) facilities to specify the lattice design, the fuel concentrations, and the control rod types and configurations for the high-flux loading. A number of additional experiments determined the following operating and safety characteristics: temperature coefficients, void coefficients, light water coefficients, and flux distributions. A final zero-power critical test was made on the production lattice prior to its insertion into the production reactor. (auth)

23715 (EUR-3126.I) MISURA DELLA COSTANTE DI MOLTIPLICAZIONE INFINITA DI RETICOLI A URANIO NATURALE E GRAFITE NELL'INSIEME CRITICO RB-1 CON IL METODO DELLA REATTIVITA' NULLA. (Measurement of the Infinite Multiplication Constant of Natural Uranium-Graphite Lattices in the RB-1 Critical Assembly by Means of the Zero Reactivity Method). Ghillardotti, G. (Societa Nazionale Metanodotti, Milan (Italy). Laboratori Reuniti Studi e Ricerche). Oct. 1966. Contract 038-64-3 TEGI. 212p. (In Italian). Dep. mn.

The development of the zero reactivity technique (PCTR) applied to natural U/graphite lattices and its comparison with the substitution method are described. The experiments were carried out in the critical assembly RB-1 at the Montecuccolino laboratory, Bologna. Two series of measurements were conducted on two lattices differing only with regard to the fuel element, one consisting of a solid 29.2 mm dia rod in a can, the other being a tube 30 mm to 50 mm OD; channel dia 70 mm square lattice pitch of 224 mm. These lattices were chosen from those tested in the Marius critical assembly by the substitution method. Results show that a consistent and complete experimental procedure has been devised for measuring the K_{∞} of natural U/graphite lattices by means of zero reactivity method. The same applies to the procedure for analysis of the experimental data. The error in $(K_{\infty} - 1)$ inherent in measurement can in our opinion be reduced to 2%. This limit was reached in the last experiment on lattices consisting of tubular elements. Agreement proved to be good with the results obtained by the CEA in the critical assembly Marius. (tr-auth)

23716 (GEAP-5285) PLUTONIUM-URANIUM MIXED OXIDE FUEL PELLET FABRICATION DEVELOPMENT FOR THE SOUTHWEST EXPERIMENTAL FAST OXIDE REACTOR. Craig, C. N.; Ryer, C. M.; Thompson, M. L. (General Electric Co., Sunnyvale, Calif. Advanced Products Operation). Oct. 1966. Contract AT(04-3)-540. 27p. Dep. mn. CFSTI $3.00 cy, $0.65 mn.

A process was developed to fabricate SEFOR-design PuO_2-UO_2 pellets with densities 85 to 96% theoretical. Geometric defects, such as end-dishing and hour-glassing typical of pellets fabricated by conventional methods, were minimized or eliminated through a

prepressing step in powder preparation. The pellet quality was ascertained by uniform O/M ratio and density measurements made as a function of radius, as well as by final chemical analysis. The process was also used successfully to fabricate pellets with dished ends of controlled geometry. (auth)

23717 (GEAP-5428) PLUTONIUM SUBCRITICAL EXPERIMENT PROGRAM. Quarterly Report No. 10, October 1–December 31, 1966. Carver, J. G. (General Electric Co., Pleasanton, Calif. Nuclear Technology Dept.). Jan. 5, 1967. Contract AT(04-3)-189. 18p. (EURAEC-1818). Dep. mn. CFSTI $3.00 cy, $0.65 mn.

Work Performed under United States–Euratom Joint Research and Development Program.

The reactor physics data measurements continue on Pu-enriched systems. A more accurate reduction of the Cu activation data indicates that Lu/Cu, Yb/Cu, and La/Cu ratios change by less than 1 per cent between core center and a point in the mid-plane at 13-cm radius. The same ratios change by 5 per cent or less between core center and a point 15 cm above. Accurate foil weights were obtained and the $^{239}Pu/^{235}U$ fission ratios at 70°F and 540°F, agreed with the calculated values within the accuracy of the measurements Resonance absorption measurements indicate that the 70°F-540°F spectrum swing is overpredicted significantly. The fission foils can be re-used after a 90-day cooling period, without creating serious problems in the measurement schedule. (auth)

23718 (IA-1112) INVESTIGATION OF MATERIAL REPLACEMENT PROBLEMS BY THE PERTURBATION METHOD. Lemanska, M.; Yiftah, S. (Israel Atomic Energy Commission, Yavne. Soreq Nuclear Research Center). Jan. 1967. 22p. Dep. mn.

The computed results of the reactivity effects obtained by substituting samples of various materials in both the ZPR-III assemblies and the small, fast critical assemblies Jezebel, Godiva and Topsy are presented. The calculations are performed using the multigroup transport perturbation code PERTR, for spherical geometry and the YOM cross section tables. (auth)

23719 (IDO-17223) TRANSIENT TESTS OF THE FULLY ENRICHED URANIUM-OXIDE STAINLESS STEEL PLATE-TYPE C-CORE IN THE SPERT III REACTOR: DATA SUMMARY REPORT. Scott, R. Jr.; Hale, C. L.; Hagen, R. N. (Phillips Petroleum Co., Idaho Falls, Idaho. Atomic Energy Div.). Feb. 1967. Contract AT(10-1)-205. 182p. Dep. mn. CFSTI $3.00 cy, $0.65 mn.

The data obtained from a transient test series of the Spert III C-core is presented. The purposes of these tests were to obtain information on the effects of various parametric changes on transient behavior and to provide an opportunity for checking models and theories of reactor behavior over a wide range of parameters. These tests were initiated by a stepwise insertion of reactivity and resulted in initial asymptotic periods ranging from approximately 10 sec to approximately 10 msec. The reactor was operated under the following range of initial system conditions: reactor power—10 watts, temperature—ambient to ≈320°C, pressure—atmospheric to 2500 psi, forced coolant flow rate—0 to 20,000 gpm. The experimental data obtained from these tests are presented in tabular form and as plots of the time behavior of reactor power, fuel plate surface temperature rise, system reactivity, and energy. (auth)

23720 (KFK-507) HETEROGENEITY EFFECTS IN SNEAK DOPPLER LOOP MEASUREMENTS. Foell, W. K. (Kernforschungszentrum, Karlsruhe (West Germany). Institut fuer Angewandte Reaktorphysik). Jan. 1967. 19p. Dep. mn.

The effects of the heterogeneity of the fuel pins in SNEAK are considered. The development of reaction rates for the different fissile materials uses first-flight collision probability equations expressed in terms of lethargy. A source term is arrived at by using a narrow resonance approximation and assuming that the scattering cross section is independent of lethargy. Introducing the reciprocity theorem and using the flat source approximation, expressions for fluxes in the different regions are arrived at. Transmission probabilities for a given slab in an infinite medium are expressed in terms of first-flight collision probabilities; these are then substituted into the flux equations to give the reaction rates. The mathematics are presented in some detail. Some illustrative examples are also given. (M.L.S.)

23721 (NP-16480) STREAK: A NUMERICAL SOLUTION FOR SPACE-TIME NEUTRON DIFFUSION EQUATIONS. Computer Program for Analysis of Prompt Nonlinear Transients in Reactors. Smiley, James W. (Pennsylvania State Univ., University Park. Coll. of Engineering). Dec. 1966. 64p. Penn. State Univ. $3.00.

STREAK is a computer program designed for analysis of prompt neutron flux transients such as those of pulsed research reactors, for hazard analysis of large power reactors, and for analyzing pulsed neutron experiments in multiplying or non-multiplying media. STREAK solves the nonlinear, one-dimensional, time-dependent neutron diffusion equations in two energy groups. Separability of space and time is not assumed. Up to six groups of delayed neutrons are allowed, and almost any feedback mechanism can be incorporated. The program has the versatility and accuracy of a finite difference solution, but can reduce computation time by a factor of 3 or more over that required by finite difference numerical integration methods. Extension to two or more dimensions is easily accomplished, and extension to more than two energy groups is possible. The STREAK program is written in DAFT, a dialect of FORTRAN for an IBM 7074 digital computer with 10,000-word memory. The description herein includes theory, preparation of input, output options, applications, computer time requirements, and a print of the complete DAFT source deck. (auth)

23722 (NP-16608) MESURE DU GRADIENT DE FLUX DANS LA CARTOUCHE D'IRRADIATION DU PNEUMATIQUE SILOE: NEUTRONS THERMIQUES. (Measurement of the Flux Gradient in the Irradiation Cartridge of the Pneumatic SILOE: Thermal Neutrons). Junod, E. (Commissariat a l'Energie Atomique, Grenoble (France). Centre d'Etudes Nucleaires). Apr. 1965. 6p. (In French). Dep. mn.

The SILOE pneumatic tube is placed in the light water reflector of the reactor and then a significant flux gradient at the interior of the irradiation cartridge is observed. Variations of 35% from one side to the other of the external diameter (42 mm) and 15% across the small bottle with 11.5 mm diameter usually used as sample container were observed. Axially the gradient is almost linear with a variation of 12% increasing from the base to the summit of the cartridge. The thermal flux variation during the course of a day in a fixed position of the cartridge was also measured and variations between -3 and +4.5% of the mean flux were observed. (tr-auth)

23723 (NP-16621) SILOE: CALCUL DES PERTES DE CHARGE DANS L'ELEMENT DE CONTROLE A BARRES FOURCHETTE TYPE ^{23}Si. (SILOE: Calculation of Pressure Drop in the ^{23}Si Fork-Type Control Rods). Merchie, F. (Commissariat a l'Energie Atomique, Grenoble (France). Centre d'Etudes Nucleaires). Dec. 8, 1965. 28p. (In French). Dep. mn.

The pressure drop in the Si-23 fork type control rod was calculated. With equal pressure drop, position of the rod does not cause the coolant velocity to vary. With equal pressure drop the variation on the input between the calculated and measured values is of the order of 4% at the most. With equal pressure drop the input in the fork rod element is weaker than in the standard Si-23 element; the velocity between plates of the fork element is almost equal to 1%, close to that of the standard Si-23 control rod. (J.S.R.)

23724 (ORNL-3573) THE HIGH FLUX ISOTOPE REACTOR ACCIDENT ANALYSIS. Binford, F. T.; Cole, T. E.; Cramer, E. N. (eds.) (Oak Ridge National Lab., Tenn.). Apr. 1967. Contract W-7405-eng-26. 287p. Dep. mn. CFSTI $3.00 cy, $0.65 mn.

The High Flux Isotope Reactor is a light-water moderated and cooled Be-reflected flux-trap reactor designed and built to operate at 100 Mw (thermal) for the primary purpose of producing significant quantities of the transplutonium isotopes. The reactor system is equipped with two types of containment. The primary containment consists of the reactor primary coolant system, including the reactor vessel and associated high-pressure piping. This system alone is capable of containing the more likely and more serious accidents. The secondary containment is accomplished by controlled leakage into, and the constant discharge from, the reactor building of ~28,600 cfm of air through appropriate filters to the 250-ft HFIR stack. The accident analysis (Part I) reveals that radiation doses following the maximum credible accident, taken to be a 50% core meltdown, would not exceed the guidelines set forth in 10 CFR, part 100. These doses would be almost entirely due to iodines and noble gases. The safety review questions and answers (Part II) record the various additional information requested by the USAEC and such design changes as occurred following the draft Accident Analysis. (auth)

23725 (ORNL-P-2854) ROSSI-α AND PULSED NEUTRON MEASUREMENTS IN SUBCRITICAL COUPLED URANIUM-METAL CYLINDERS. Mihalczo, John T. (Oak Ridge National Lab., Tenn.). [1965]. Contract W-7405-eng-26. 22p. (CONF-670107-4). DTIE.

From American Nuclear Society, Coupled Reactor Kinetics Conference, College Station, Tex.

Three pairs of coaxial 27.94-cm-dia cylinders of unmoderated and unreflected U metal have been assembled with 36.94 cm between the flat surfaces and cylinder heights of 6.042, 6.676, and 7.314 cm. The U was enriched to 93.15 wt % in the ^{235}U isotope. The prompt neutron time behavior in all three assemblies was

measured by the Rossi-α and in one assembly by the pulsed neutron technique with the detectors in a variety of locations. The results are compared with those predicted by a calculation in which a pair of equations represented the kinetics of a coupled-core assembly. The equations neglected delayed neutrons and assumed space-independent kinetics for each cylinder with a time lag to represent the flight time of neutrons from one cylinder to the other. The Monte Carlo method was used to calculate the coupling coefficients and the flight time. (auth)

23726 (ORNL-TM-926) FISSION GAS RELEASE EXPERIMENT WITH A UO_2 FUEL ELEMENT IN A HIGH-TEMPERATURE HELIUM RECIRCULATING LOOP. Longest, A. W.; Conlin, J. A. (Oak Ridge National Lab., Tenn.). Feb. 1965. Contract W-7405-eng-26. 74p. Dep. mn. CFSTI $3.00 cy, $0.65 mn.

A fission gas release experiment was irradiated in the GCR-ORR helium-cooled hoop 1 employing an EGCR-type element. Activity release from the element was measured by radiation detectors on the loop piping, gas sampling, and analysis of the plate-out of long-lived fission products on several of the fuel element lead tube parts in the gas stream. Isotopic equilibrium activities in the loop gas were predicted and compared with in-pile test results. (M.L.S.)

23727 (ORNL-TM-1739) THE EFFECT OF FISSION PRODUCTS ON CHARCOAL IGNITION (IN-PILE EXPERIMENT). Shields, R. P.; Miller, C. E. Jr. (Oak Ridge National Lab., Tenn.). Jan. 10, 1967. Contract W-7405-eng-26. 31p. Dep. mn. CFSTI $3.00 cy, $0.65 mn.

In the event of a nuclear accident in which fission products were released into the containment system, the charcoal adsorbers used for removal of I_2 would be subject to rapid loading. If air were present but not flowing, the heat generated in the adsorber by decay of fission products might raise the temperature of small areas of the charcoal adsorber to the point where the resumption of air flow would ignite the charcoal bed. An in-pile experiment has been performed to study hot spot effects under conditions which simulate those in the adsorber during a reactor accident. The ignition temperature of the charcoal tested was increased by the presence of fission products. Although the charcoal adsorber was loaded with much more radioactive I_2 per unit of front surface than expected in adsorbers such as in HFIR and NPR, there has been no evidence of hot spot effects. (auth)

23728 (RCN-65) DIGITAL REACTIVITY MEASUREMENTS BY A ROD DRIVE METHOD. Tuerkcan, E. (Reactor Centrum Nederland, Petten). Feb. 1967. 16p. Dep. mn.

The rod drive method finds the worth of a control rod in a short time. The method has been in use at Petten R.C.N. for more than a year for obtaining reactor control rod calibration curves and water-height reactivity coefficients in the Argonaut type low flux reactor, in the KRITO (critical experiment for a ship propulsion reactor) and in the high flux reactor H.F.R. The value of the reactivity controlled by a control rod is deduced from an analysis of the digitally measured reactor response to a slow movement of the control rod. Reactivity is obtained as a function of time, which can be easily converted to rod position. By using an automatic switching amplifier very large reactivity worths (up to $-5\% \Delta k/k$) were measured with an accuracy, in the limit of one energy group, space independent kinetic equations, of few dollar cents. The method has also been used for measuring water-height reactivity coefficients. The results are found to be in good agreement with those obtained with the positive period method. (auth)

23729 (WAPD-T-1852) MEASUREMENT OF FAST ADVANTAGE FACTORS AND INTRA-CELL FLUX SHAPES IN SEVERAL LIGHT-WATER-MODERATED, SLIGHTLY ENRICHED URANIUM LATTICES. Hardy, J. Jr.; Klein, D. (Bettis Atomic Power Lab., Pittsburgh, Pa.). Sept. 1965. Contract AT(11-1)-Gen-14. 13p. (CONF-651101-55). Dep. mn. CFSTI $3.00 cy, $0.65 mn.

From 13th Conference on Remote Systems Technology, Washington, D. C.

Measurements and calculations of spatial variations of fast flux within slightly-enriched water-moderated U lattices are given. Theoretical results were obtained from detailed Monte Carlo calculations and from simple one-group calculations. These were compared with experimental determinations from foil activation flux measurements. (M.L.S.)

23730 (JPRS-39787) SPATIAL DISTRIBUTION OF REACTOR RADIATION AROUND THE HORIZONTAL CHANNEL OF THE RA REACTOR AT VINCA. Ninkovic, Marko; Paligoric, Dragica; Vujisic, Branislav. Translated from Tehnika (Belgrade), 22: 13-19(1967). 11p. (TT-67-30435). CFSTI $3.00 cy, $0.65 mn.

The measurement of the spatial distribution of thermal and fast neutrons and gamma rays in and around a beam of reactor radiation that passes through the horizontal experimental channels outside the biological protection of the reactor is discussed. This beam of radiation presents a potential danger for the people inside the reactor building. The results obtained are intended to be used in the specification of the optimal distribution of protective components around the free beam of radiation. (JPRS)

23731 PEGASE REACTOR. Deville, A. Energ. Nucl. (Paris), 9: 3-10(Jan.-Feb. 1967). (In French).

Operations of the Pegase reactor over the last three years are discussed. Experimental facilities and testing programs for nuclear fuels are described. (M.L.S.)

23732 OSIRIS. Bull. Inform. Sci. Tech. (Paris), No. 111, 1-84(Jan. 1967). (In French).

A description is presented of the swimming-pool pile Osiris, a 50-MW high flux reactor designed particularly for the irradiation of structural materials for future power reactors, and characterized by easy access to the core. The design of the reactor is described along with its annexes. The neutron characteristics, cooling system, control methods, treatment of measurements and signals are described, and constructional and safety problems are reviewed. The possibilities available to researchers are indicated. Iris, a low-power mock-up of Osiris, is also described. (tr-auth)

23733 TEST PROGRAM FOR FUELS TO BE USED IN PEGASE. Ollier, H.; Renaud-Salis, F. (CEA, Saclay, France). Energ. Nucl. (Paris), 9: 11-20(Jan.-Feb. 1967). (In French).

Results from the testing of fuel elements for the gas-graphite and heavy water reactors are given. Tests were conducted in the Pegase reactor and included the following: verification of out-of-pile fuel element testing by use of thermocouples in either the fuel or the sheath; creep tests on the uranium tube or the total behavior of the fuel element; testing at limits of possible use of fuel elements. (M.L.S.)

23734 REACTOR KINETICS OF A REFLECTED SLAB. Garelis, Edward (General Electric Co., Pleasanton, Calif.). Nukleonik, 9: 187-94(Mar. 1967).

A study of the pulsed time behavior of a reflected slab reactor is presented using a simple one group symmetrically reflected diffusion theory model with delayed neutrons. A comparison of this model with a bare assembly shows the effect introduced by the inhomogeneity of a reflector. Furthermore, the analysis gives a comparison of the reactivity as determined from a static calculation with the reactivity as determined from dynamic measurements. (auth)

23735 EQUIPMENT OF TWO HORIZONTAL CHANNELS OF THE IRT REACTOR IN SOFIA FOR CARRYING OUT RADIOBIOLOGICAL WORK AND STUDYING THEIR RADIATION FIELD. Hristov, V.; Damyanov, D.; Stanolov, A.; Yovchev, G. Izv. Fiz. Inst. Aneb, Bulg. Akad. Nauk., 15: 165-76(1966). (In Russian).

A brief description is given of the experimental equipment for the remote irradiation of biological objects on the 1st and 2nd horizontal channels of the IRT Reactor in Sofia in relatively pure fluxes of fast and thermal neutrons. In connection with the planning of biological protection, the protective properties of mixtures of iron ore and hydrogen-containing substances have been studied. The relaxation lengths in these materials for the fast neutrons are given. Use has been made of the semi-emperical method of the "removal cross-section." The action of the B–Bi filter according to its position along the axis of the 1st horizontal channel has been investigated. The transmission coefficients of the filter for the fast neutrons and the gamma-rays of the reactor have been measured and its optimal geometrical position has been determined. Data have been obtained for the radiation field of the two channels. For the accurate measurement of the tissue doses the authors have made use of the ionisation method of two Greyv's homogeneous chambers. The effectiveness of the chambers has been calculated assuming that the spectrum of fast neutrons of the 1st horizontal channel is a fission spectrum. (auth)

23736 THE RESEARCH REACTOR JEEP II. Sekkesaeter, H. (Institutt for Atomenergi, Kjeller, Norway). Tek. Ukeblad., No. 11, (1967). (In Norwegian).

The research reactor JEEP II, with emphasis on performance tests and manufacturing problems, is described. The JEEP II, which will replace the veteran reactor JEEP, has been designed to provide facilities for isotope production, irradiation experiments, and experiments in solid state and nuclear physics and radiochemistry. (auth)

23737 A THEORETICAL ANALYSIS OF PULSED NEUTRON EXPERIMENTS IN SHE. Amano, Fumio. Nippon Genshiryoku Gakkaishi, 9: 7-15(Jan. 1967). (In Japanese).

A theoretical analysis of pulsed neutron experiments on the SHE (Semi-Homogeneous Critical Assembly) is described. Analysis of experiments has been performed using the time-dependent, two-

group diffusion theory neglecting delayed neutrons. A comparison is made between measured and calculated values representing the effectiveness of gray control rods. The relation between the spatial harmonic contamination and the manner in which the reactor system is made subcritical is investigated. The relative positions of neutron source and detector to minimize the harmonic effects are decided. The error resulting from higher harmonics with a single-mode fitting method based on the response of a single detector is evaluated. (tr-auth)

23738 STUDY BY NEUTRON SPECTRUM MEASUREMENTS OF A THERMAL AND COLD NEUTRON SOURCE TO BE USED IN A FAST PULSED REACTOR. Arcipiani, B.; Fraysse, G.; Menardi, S.; Riccobono, G. (CCR-EURATOM, Ispra, Italy). Energ. Nucl. (Milan), 14: 151-60(Mar. 1967).

Measurements are described of the energy distribution of the neutrons emerging from arrangements of light water and a mixture of H_2O and heavy water in cylindrical geometries, both at room and liquid nitrogen temperatures, following the injection of a fast neutron burst. The results of the investigations of the die-away process of the neutrons in these assemblies are also shown and discussed. (auth)

23739 A FACILITY FOR k_∞ MEASUREMENTS ON D_2O LATTICES IN THE RB-1 REACTOR. Casali, F. (CNEN, Ispra, Italy); Casini, G.; Cenerini, R.; Cordani, G.; Rustichelli, F.; Sturm, B.; Zappellini, G. Energ. Nucl. (Milan), 14: 178-81 (Mar. 1967).

A description is given of the D_2O facility for measurements of k_∞ in heavy water lattices. A general description of proposed activation analysis experiments with ORGEL-type fuel elements is briefly outlined. (M.L.S.)

23740 GAS CHROMATOGRAPHIC SEPARATION AND γ SPECTROMETRIC ANALYSIS OF WWR-M REACTOR GASES. Solov'ev, V. A.; Stepanets, O. V.; Trenin, V. D. At. Energ. (USSR), 21: 417-18(Nov. 1966). (In Russian).

The installation for gas chromatographic separation of microcomponents of the gases from the WWR-M reactor is sketched and described. The γ spectrometric technique used for analysis of the gas microcomponents is outlined. The technique makes it possible to determine more rapidly and clearly the microcomponents without carrier. (J.S.R.)

23741 METHOD FOR CALCULATING AVERAGE THERMAL NEUTRON PARAMETERS. Bulmer, J. J.; Daitch, P. B. (Rensselaer Polytechnic Inst., Troy, N. Y.). Nucl. Sci. Eng., 28: 145-8(Apr. 1967).

An integral transport model that can be used to calculate η and f for homogeneous and heterogeneous $U-H_2O$ and $Pu-U-H_2O$ lattices is described. The model can also be used to provide a unified treatment of resonance and thermal absorption. (D.C.W.)

23742 SOME STUDIES OF THERMAL AND EPITHERMAL NEUTRON SPECTRA IN HETEROGENEOUS SYSTEMS. Johansson, E. Goteborg, Chalmers Tekniska Hogskola, 1966. 34p. Thesis.

Neutron spectra measurements have been carried out with the fast chopper at the reactor R1 in Stockholm. These experiments, covering the energy range from 0.006 to 10,000 eV, show the spectrum in the moderator of the reactor. Spectra have been measured in a reactor channel and in special cells in the channel. (auth)

23743 IMPROVEMENTS IN AND RELATING TO NUCLEAR REACTORS OF THE POOL TYPE. (to Societe Grenobloise d'Etudes et d'Applications Hydrauliques). British Patent 1,061,276. Mar. 8, 1967. Priority date Apr. 5, 1963, France.

A design is given for a swimming pool type reactor in which the water is circulated such that highly contaminated water never reaches the surface of the pool. The core is placed inside a vertical caisson located in the center of the pool. The cooling water is circulated through the caisson and out of the pool, being so directed as to prevent any high level contamination from rising to the surface. (M.L.S.)

Reactor Components, Fuels and Accessories

Refer also to abstracts 22172, 22191, and 23710.

23744 (IA-1069) THE MULTIGROUP DIFFUSION PERTURBATION ALTAC CODE FOR THE PHILCO-2000 COMPUTER. Lemanska, M.; Yiftah, S. (Israel Atomic Energy Commission, Yavne. Soreq Nuclear Research Center). Dec. 1966. 20p. Dep. mn.

PERDIF is a first order perturbation code based on the multigroup multiregion diffusion equation for spherical geometry. It is programmed for the Philco-2000 computer in ALTAC mnemonic language. The code may be used to calculate the change in k_{eff} obtained by perturbations of the material cross sections in a single region of a reactor. The fluxes and adjoint fluxes required by the perturbation formula are obtained by the DIFAL and DIFAD codes. (auth)

23745 (IITRI-578P21-19) STUDIES OF REACTOR CONTAINMENT. VOLUME III. SELECTION OF EQUATIONS-OF-STATE FOR BLAST SHIELD DESIGN. Final Report. Lieberman, Paul (IIT Research Inst., Chicago, Ill.). Feb. 1967. Contract AT(11-1)-578. 214p. Dep. mn. CFSTI $3.00 cy, $0.65 mn.

The study comprises graphical, analytical, and computer solutions to the impact problem in the five types of equation of state for the one-, two-, and four-layer blast shields. It is assumed that the blast shields are exposed to a square-wave pressure-time history at the impingement surface and supported by a rigid wall. One-layer blast shields, two-layer blast shields, (two elastic materials and two shock-dispersive materials), and a four-layer blast shield (two elastic materials in alternating layers) are studied. The results show the effect of impedance mismatch between the two layers and the effect of the Hugoniot elastic limit within each layer. The one- and two-layer arrangements of the same dispersive material and the two- and four-layer arrangements are compared for blast shield effectiveness. Minimization of the peak reflected stress at a support structure is prime consideration. However, it is important to note that shell structures may rupture not only as a result of peak reflected stress, but also as a result of total impulse or total energy sensitivity. For example, the minimization of a peak reflected stress may induce spallation of the blast shield away from the support structure to be protected, thereby amplifying the total impulse of the applied load which the support structure must absorb. (auth)

23746 (ORNL-TM-1760) ESTIMATION OF RESONANCE EFFECTS IN FUEL BURNUP ANALYSIS. Olsen, A. R.; Prados, J. W. (Oak Ridge National Lab., Tenn.). Mar. 1967. Contract W-7405-eng-26. 24p. Dep. mn. CFSTI $3.00 cy, $0.65 mn.

A computer program, RCROSS, which calculates time-averaged thermal flux, resonance-to-thermal flux ratios and atomic percent heavy metal burnup for U fuels is described. The input data required are the irradiation time, the preirradiation and postirradiation U isotopic analyses for the fuel, and literature values for the various neutronic constants. (auth)

23747 (UJV-1622) METODIKA RESENI OKRAJOVYCH ULOH PRO PODELNE ZEBROVANE PALIVOVE CLANKY JADERNYCH REAKTORU. (The Method of the Solution of Heat Conduction Boundary Problems of Longitudinal Finned Reactor Fuel Elements). Schmid, J. (Ceskoslovenska Akademie Ved, Rez. Ustav Jaderneho Vyzkumu). 1966. 113p. (In Czech). Dep. mn.

A method for the solution of bidimensional boundary problems of heat conduction in fuel elements of nuclear reactors (at simplified boundary conditions), especially those related to longitudinally finned fuel elements, was investigated. Longitudinal fins were assumed to be of annular (or circular) sector or prisma forms. The problem was studied for any distribution of heat sources and for boundary conditions varying along the periphery with the limitation that the problem is symmetric with respect to all symmetry axes of the fins. Problems relating to laminar flow in noncircular channels may also be solved by the same method. (auth)

23748 (ORNL-tr-1526) ANALYTICAL ESTIMATES FOR AN OPTIMUM CHOICE AND CONFIGURATION OF MATERIALS IN REACTOR SHIELDS. Schultz, H.; Sasse, S. (Technische Hochschule, Hanover (West Germany)). Translated for Oak Ridge National Lab., Tenn., from report ABS-THH-1024. 62p. Dep. mn. CFSTI $3.00 cy, $0.65 mn. JCL $6.60 fs, $2.06 mf.

Efforts devoted to the derivation of suitable computer program optimization principles on the basis of simplified models to obtain first approximations of optimum shield composition are described. The approximations can be improved in a few steps using numerical methods resulting in a true optimum. A description is included concerning radiation attenuation mechanisms, and methods of determining material shielding properties are summarized. Information is included on optimization of independent and coupled energy groups, spherical reactor shield design, and material attenuation calculations. (J.R.D.)

23749 DISCHARGE AND BY-PASS SAFETY VALVE FOR HIGH-PRESSURE BOILERS. SOME DATA ON DESIGN OF THE VALVE FOR THERMONUCLEAR PLANT. Goidanich, G. Termotecnica (Milan), 20: 524-8(1966). (In Italian).

The design of a discharge valve and a prestarter bypass valve for use in high pressure boilers in thermoelectric plants are given. The rigid requirements placed on valves for use in nu-

clear power plants are outlined. The design of some typical valves is given. (J.S.R.)

23750 FUEL IRRADIATION RESEARCH AND DEVELOPMENT IN JAPAN. Taketani, Kiyoaki (Japan Atomic Energy Research Inst., Tokyo). Nippon Genshiryoku Gakkaishi, 9: 72-82(Feb. 1967). (In Japanese).

The status of fuel irradiation research and development in Japan, including the activities of the Japan Atomic Energy Research Institute (JAERI), the Atomic Fuel Corporation and of five industrial consortia is reported. Experience on fuel irradiation obtained by these organizations is described, such as fuel irradiation experiments nuclear and thermodynamic problems, materials and structural design problems and the difficulties that must be smoothed out in order to proceed further with fuel irradiation in Japan. Results obtained from the irradiation of fuels in JAERI and abroad, and future plans for fuel irradiation are also described. (auth)

23751 ERRORS IN MEASUREMENTS OF BUILDING LEAKAGE DUE TO TRANSIENT TEMPERATURE EFFECTS. Nelson, C. T.; Greenfield, M. A.; Koontz, R. L. (Atomics International, Canoga Park, Calif.). Nucl. Eng. Design, 5: 207-13(Mar. 1967).

Sources of errors in determining leakage rates of a containment structure, when a reference vessel method is used are analyzed. The largest errors are shown to be due to a combination of a temperature lag between reference vessel and containment structure, and from temperature fluctuations during the testing period. (auth)

23752 MULTILAYER (DOUBLE-WALL) PRESTRESSED CONCRETE PRESSURE VESSEL. Bremer, F. (Fried. Krupp Universalbau, Essen). Nucl. Eng. Design, 5: 183-90(Mar. 1967).

A multi-layer (double-wall) prestressed concrete reactor pressure vessel with intermediate water gap under automatic pressure equalization with the reactor cooling medium is described. Each layer in the composite vessel has assigned its special function, the prestressed concrete of the actual load-bearing outer wall being outside of any thermal and radiation influence. A versatile and efficient stress analysis program based on the dynamic relaxation concept has been set up in context with the vessel development and an extensive series of bi-and tri-axial concrete strength tests has been performed. (auth)

23753 RIGIDITY OF PERFORATED PLATES WITH REINFORCED HOLES. Abdul-Wahab, H. M. S. (Univ. of Sheffield, Eng.); Harrop, J. Nucl. Eng. Design, 5: 134-41(Mar. 1967).

A method of analysis of perforated plates with reinforced holes on a triangular pattern is developed. The behavior of the plate under both in-plane loading and peripheral bending moment is considered. Typical curves for the effective rigidity are included for a wide range of modular ratio, liner thickness and ligament efficiency. Experimental verification of the analysis is reported and comparison with other solutions is made. The investigation, though in general terms, applied particularly to the effects of the hole reinforcement on the rigidity of the loading face of concrete pressure vessels for nuclear reactors. (auth)

23754 NOTE ON STRESSES AND DISPLACEMENTS IN SQUARE PLATES AND CYLINDERS WITH PRESSURIZED CENTRAL CIRCULAR HOLES. Slot, T. (General Electric Co., Cincinnati). Nucl. Eng. Design, 5: 142-9(Mar. 1967).

Accurate elastic solutions for perforated squares subjected to internal pressure are reported for hole dia-to-plate width ratios of 0.5, 0.6, 0.7, 0.8, 0.85 and 0.9. A point-matching procedure is used to generate solutions that satisfy the internal boundary conditions exactly and the external boundary conditions approximately. The degree of approximation is examined by inspection of residual tractions along the outer boundary. Plane-stress and plane-strain conditions are considered, and the superposition by which the solutions for external pressure can be obtained from the solutions for internal pressure is indicated. (auth)

23755 SHRINKAGE IN CONCRETE PRESSURE VESSELS. Ross, A. D. (London Univ.); Parkinson, J. D. Nucl. Eng. Design, 5: 150-60(Mar. 1967).

The results of experiments at model scale on shrinkage under conditions simulating those in a concrete reactor pressure vessel are presented. In addition to measuring shrinkage, the transfer of moisture in the concrete was traced by microwave attenuation. A zone of drying and shrinkage develops adjacent to the heated face and the overall temperature gradient is an important parameter in the extension of this zone. By extrapolation an attempt is made to estimate the long term distribution of shrinkage in a 12-ft thickness under specified thermal conditions. (auth)

23756 STUDY OF THE DYNAMIC BEHAVIOR OF A THERMOELASTIC MEDIUM. Papa, G.; Tarantini, A. (CNEN, Bologna). Riv. Ing. Nucl., 4: 1007-14(Mar.-Apr. 1966). (In Italian).

Within the framework of a study on the design of a pulse reactor having fuel elements in the form of thin circular disc, the equation describing the dynamic behavior of a thermoelastic medium were derived. (J.S.R.)

23757 THE COMING STEELS FOR NUCLEAR PRESSURE-VESSEL SERVICE. Sterne, Robert H. Jr. (Lukens Steel Co., Coatesville, Pa.). Nucleonics, 25: No. 3, 60-5(Mar. 1967).

The need for higher strength steels for pressure-vessels in larger nuclear power plants is discussed from the viewpoint of mechanical properties, cost, radiation-induced embrittlement, specifications, and safety. (P.G.C.)

23758 DETECTION OF CLADDING FAILURE IN A REACTOR BY MEASURING THE COOLING WATER ACTIVITY. Alexan, Z.; Purica, I.; Ionescu, E. (Inst. for Atomic Physics, Bucharest). Rev. Roum. Phys., 11: 747-50(1966).

The possibility of detecting cladding failure by examining the appearance of the 0.106-MeV peak in the γ radiation emitted by the ^{239}Np in the VVR-S reactor cooling-water was previously shown. The occurrence of the cladding failure of one rod followed by observation of the γ activity of the primary circuit water, confirmed the previous conclusions. (auth)

23759 MATERIALS FOR REACTOR FUEL ELEMENTS. Fritz, Kurt (International Atomic Energy Agency, Vienna). Riv. Ing. Nucl., 3: 868-87(Sept.-Dec. 1965). (In Italian).

A bibliographic review is given of the most important properties of materials used in the composition of nuclear fuel elements. These include U, Pu, Th, Al, Mn, Zr, stainless steel, Ni, Be, graphite, Cr, Mo, W, V, Ti, Ta, and coated particles. (232 references). (J.S.R.)

23760 INVESTIGATIONS OF IRRADIATED NUCLEAR REACTOR MATERIALS. Neeb, K. H.; Spang, A. (Siemens-Schuckertwerke AG, Erlangen, Ger.). Atompraxis, 13: 67-72(Feb. 1967). (In German).

Three working techniques are currently used for the investigation of irradiated nuclear materials. The local distribution of H_2 in the wall of Zircaloy-2 fuel casings (thickness 0.61 mm) is determined by a combination of metallographic techniques and vacuum hot extraction analysis. In order to establish the fission gas concentration in the gas compartments of the irradiated fuel rods they are punctured within a hot cell; the gases are sampled by pumping, and their composition is determined by mass spectrometry. Systematic errors in the analysis of ^{235}U burn-up are investigated by the simultaneous determination of the fission products ^{137}Cs, ^{144}Ce, and ^{90}Sr; the resulting special values show good agreement. (tr-auth)

23761 STABILITY STUDIES ON THIN-WALLED FUEL ELEMENTS. Assmann, H.; Steinberg, E. (Siemens-Schuckertwerke AG, Erlangen, Ger.). Atompraxis, 13: 72-7(Feb. 1967). (In German).

The mechanical behavior of UO_2-filled fuel elements with tight-contact thin-walled cans of austenitic stainless steel was studied in a series of out-of-pile tests. The main problems dealt with were the formation of ridges and the low-cycle-stretch. Suitable test-rigs were built for the tests. The development of ridges and their variation with time were observed. Longitudinal ridges on thin-walled casings lead to premature fracture in the case of thermal cycling, but their formation can be prevented by taking suitable measures. Low-cycle-fatigue on casings without ridges was investigated at constant external pressure under thermal cycling conditions corresponding to those expected in the reactor. The number of stretch cycles prior to fatigue fracture depends on the temperature interval of the thermal cycles and is represented by a Manson–Coffin-relation. (tr-auth)

23762 REACTOR FUEL ELEMENT. Matsumoto, Masayoshi; Morita, Takahiro (to Hitachi, Ltd.). Japanese Patent 1966-8758. May 9, 1966. Filed Jan. 28, 1963.

In a reactor fuel element, fuel rods are placed in parallel with the direction of flow of a coolant. Propositions are made for the placement perpendicularly to the direction of coolant flow for reasons of possible increase in the heat transfer and the advantage in thermal conditions. The reactor fuel element consists of a group of fuel rods. The reactor core is made up of many, highly enriched thin fuel rods, and the outer region of the reactor core is constituted of many, slightly enriched thick fuel rods. The fuel rods in the element run horizontally perpendicular to the direction of the coolant flow. (NSA of Japan)

23763 REACTOR CONTROL ROD. Komuro, Takajiro (to Hitachi, Ltd.). Japanese Patent 1966-7520. Apr. 16, 1966. Filed Sept. 23, 1963.

A reactor control rod is described. Through the axis of the control rod is installed a tube with holes penetrating the wall. The gas produced in the control material flows through these holes into the central tube. (NSA of Japan)

23764 ELEMENTS CONSTITUTING A REACTOR CONTROL ROD. Nakamura, Shoichiro (to Hitachi, Ltd.). Japanese Patent 1966-7519. Apr. 16, 1966. Filed Sept. 17, 1963.

The neutron-absorbing power of a control rod can be increased. A rectangular cladding tube of a control rod is used instead of the usual circular one. The control element in the shape of a cube is produced by sintering neutron-absorbing material with small quantities of graphite and clay. The rectangular cladding tube is packed with these cubic control elements. (NSA of Japan)

23765 METHOD FOR CLADDING A NUCLEAR FUEL ELEMENT. Kamamoto, Tatsuro (to Furukawa Electric Co., Ltd.). Japanese Patent 1966-6439. Apr. 8, 1966. Filed Apr. 27, 1963.

Improved Magnox-clad metallic uranium fuel elements are described. A U rod is first inserted into the Magnox cladding tube. This tube with the rod is pressurized at 300–1500 kg/cm^2 under the temperature of 100–300°C, to compress the tube. The compressed tube with the U rod is again pressurized at 20 kg/cm^2 and a temperature of 300–380°C, to clad tightly the U rod with Magnox. (NSA of Japan)

23766 SUPPORT (STRUCTURE) FOR A REACTOR CORE. Sato, Sadao (to Fuji Electric Mfg. Co., Ltd.). Japanese Patent 1966-9117. May 14, 1966. Filed Feb. 13, 1963.

In the reactor core support design, the thermal expansion of the core and of its support are utilized and the comparatively high and stable fastening power is obtained. When the reactor is in operation the core is compressed firmly from outside, and when not in operation the reactor core becomes loose. The fuel elements in the core separate to facilitate the fuel replacement. In the high-temperature gas cooled reactor whose core is put together by means of its basket-shaped support, a cap body made of a high thermal-expansion material is attached to the top of the respective cluster-type fuel elements. The support-basket surrounding the reactor core is made of a material of smaller thermal expansion than that of the cap-body material. Due to the difference in thermal expansion between the two materials, when the reactor is in operation, the reactor core is compressed tightly from outside; and when not in operation, the elements become loose from each other to facilitate the fuel replacement. (NSA of Japan)

23767 DEVICE FOR CONNECTING A CONTROL ROD TO THE DRIVE. Masuda, Yasuhisa; Tsuji, Akiteru (to Tokyo Shibaura Electric Co., Ltd.). Japanese Patent 1966-6800. Apr. 6, 1966. Filed Jan. 19, 1963.

The reactor core includes many fuel rods, the control rods inserted among the fuel rods, the drive for moving the control rods up and down, and the devices for connecting the drive and the control rod. Through the control rod is bored a hole along its axis, and through this hole is run a wire. By means of this wire, the control rod is connected to or released from the connecting device, which connects to the control rod drive. (NSA of Japan)

23768 METHOD FOR CONTROLLING A REACTOR. Akimoto, Seiichi (to Hitachi, Ltd.). Japanese Patent 1966-9118. May 14, 1966. Filed Apr. 1, 1963.

In the reactor control method given, a liquid neutron-absorbing material is employed, and a variety of its applications is possible. A solution of a neutron-absorbing substance, H_3BO_3, whose solubility is determined by the temperature, is passed through the reactor core, the neutron-absorbing power of this solution is determined by the concentration of H_3BO_3. The reactor can be controlled by changing this concentration, which is in turn controlled by the temperature. A saturated solution of H_3BO_3 is circulated through a closed pipe-line, part of which is in the reactor core. In the pipeline the solution is filtered to trap crystal grains of the neutron-absorbing boric acid, and also, a heater and cooler to adjust the temperature of the circulating solution is installed. Thus by changing the concentration in the saturated solution, the reactor can be controlled. (NSA of Japan)

23769 REACTOR CONTROL ROD. Nakamura, Shoichiro (to Hitachi, Ltd.). Japanese Patent 1966-7518. Apr. 16, 1966. Filed Sept. 17, 1963.

An improved hollow control rod is described. Neutron-absorbing powder fills the space formed between the outer and inner cans. By the use of this neutron-absorbing powder, the weight of the control rod is reduced, and a means is provided to prevent the occurrence of a cavity due to the vibrations. A number of annular spacers is installed between the outer and inner cans through the length of the control rod. Both edges of the annular space are in contact with the two walls. The remaining space is filled with neutron-absorbing powder. (NSA of Japan)

23770 IMPROVEMENTS IN OR RELATING TO NUCLEAR REACTOR FUEL ELEMENTS. Gittus, John Harry (to United Kingdom Atomic Energy Authority). British Patent 1,063,691. Mar. 30, 1967. Filed Jan. 10, 1963.

Three nuclear reactor fuel element assemblies of cylindrical ceramic fuel materials enclosed in thin walled metallic cladding are presented. (J.C.W.)

23771 SHOCK ABSORBER FOR USE IN THE CONTROL-ROD DRIVE. Sasaki, Seisho; Ishii, Yoshimi (to Hitachi, Ltd.). Japanese Patent 1966-6799. Apr. 6, 1966. Filed Apr. 5, 1963.

An improved shock absorber for the rapid insertion of a reactor control rod is described. When a control rod is rapidly inserted into the reactor core, the armature drops, the plunger is lowered through the actuator, and oil is displaced through a narrow gap connected to a reservoir that is open to the atmosphere. An oil separator and an air filter are incorporated in the reservoir. (NSA of Japan)

23772 HANDLING MACHINE FOR NUCLEAR REACTORS. Hainzelin, Jean; Clausse, Robert (to Electricite de France). British Patent 1,064,820. Apr. 12, 1967. Priority date Dec. 20, 1962, France.

A fuel handling machine design is described for use with gas-cooled graphite-moderated reactors in which the fuel cartridges are stacked inside vertical channels and either charged or discharged during service by the machine which is located above the pressure vessel. The loading machine has access to the pressure vessel interior through standpipes or charge chutes. Methods of component replacement, and machine maintenance are also described. Drawings are included. (J.R.D.)

23773 IMPROVEMENTS IN OR RELATING TO FUEL ELEMENTS FOR NUCLEAR REACTORS. Saunders, Alan Charles Anthony (to United Kingdom Atomic Energy Authority). British Patent 1,065,853. Apr. 19, 1967. Filed Jan. 30, 1964.

Design of fuel elements having attached thermocouple cables is described. A device is included in the design for severing the cables prior to fuel element unloading. This allows fuel element discharge using machinery normally used with elements having no thermocouple attachments. (J.R.D.)

23774 NUCLEAR FUEL ELEMENT. Gauthron, Maurice (to CEA). British Patent 1,065,465. Apr. 12, 1967. Priority date Nov. 5, 1964, France.

Design of a fuel element cluster is described in which the fuel elements in the form of canned rods are interconnected in parallel and retained by an outer annular jacket. The overall configuration of the cluster is polygonal in cross section, some sides of the polygonal being concave. (J.R.D.)

23775 FUEL ELEMENTS. Smith, Samuel Spenceley; Hayfield, Peter Charles Steele (to Nuclear Developments Ltd.). British Patent 1,060,832. Mar. 8, 1967. Filed Nov. 12, 1963.

A method is given for the production of uranium or uranium alloy fuel elements and includes the removal of any uranium carbide in the fuel or on the surface. This removal results in decreased chemical reactivity of the surface. (M.L.S.)

23776 HEAT EXCHANGER. (to Sulzer Brothers Ltd.). French Patent 1,408,488. July 5, 1965. Priority date Oct. 3, 1963, Switzerland.

The heat exchanger for a nuclear reactor plant comprises box-shaped elements of rectangular horizontal cross-section which are closed at the sides by walls and are open at the top and at the bottom. Each element contains a number of tube nests for a heat receiving medium arranged side by side. Each tube nest has a tube coiled serpentine-fashion in a vertical plane while the tube nest connections for both the supply and discharge of the heat-receiving medium are at the top or at the bottom of the element. (I.I.B.)

23777 ROD-HANDLING EQUIPMENT FOR A NUCLEAR REACTOR. (to General Dynamics Corp.). French Patent 1,417,193. Oct. 4, 1965. Priority date Sept. 17, 1963, United States.

A refueling machine adapted for handling reactor rod elements, such as reactive fuel elements, reflector rods, dummy fuel elements, control rods and the like, is placed in such a way as to operate in an access opening extending upwardly from the reactor core. The machine is adapted to grasp and support a selected rod element at the lower end of the rod in order to maintain the rod element in compression when the rod is being handled, thus preventing damage to rod elements, which may be weak in tension. At their lower ends the rod elements are supported on fixed seats which are positioned in the bottom of the core and permit only upward sliding movement of the rods. The upper end of the rod element remains free to be engaged by other handling means. While being moved, the rod elements are also restrained at their upper ends, so that they are securely retained from displacement even when moved at relatively high speed. (I.I.B.)

23778 SHIELDING FOR A NUCLEAR REACTOR. (to United States Atomic Energy Commission). French Patent 1,435,415. Mar. 7, 1966. Priority date May 26, 1964, United States.

The fuel tube of a nuclear reactor passes through a sleeve mounted in the shield. The sleeve has a conical portion and a cylindrical portion. The conical portion extends through the inner half of the shield and loosely receives the fuel tube, while the cylindrical portion of the sleeve extends through the outer half of the shield and fairly closely fits the fuel tube without being tight thereon. Just beyond the sleeve, the fuel tube has another sleeve which is fixed therein. This second sleeve can move out of abutment with the first one, if the fuel tube moves because of the thermal expansion. When differential expansion of the reactor core and the shield causes the fuel tube to be moved transversely of its axis, the conical portion of the sleeve permits such movement. (I.I.B.)

23779 LIQUID MODERATED NUCLEAR REACTOR. (to Societe Anglo-Belge Vulcain S.A.). French Patent 1,434,936. Mar. 7, 1966. Priority date Nov. 19, 1962, Great Britain.

The reactor is provided with a cellular core lattice having a series of slots therein arranged sequentially across the core, so as to define a fuel free slab shaped zone penetrating the core. A number of slot shaped control absorbers are movable in the fuel free zones and are hollow and open ended to enclose moderator when inserted into the fuel free zones. (I.I.B.)

23780 DEVICE FOR LOADING ATOMIC REACTORS. Kumpf, H.; Weber, R.; Ropers, J.; Gallwas, J. (to Siemens-Schuckertwerke Aktiengesellschaft). Canadian Patent 751,562. Jan. 24, 1967. Priority date June 30, 1961, Germany.

A trolley supported above the reactor is adapted to position the machine above the cooling channel and is provided with a retaining member attached to the undercarriage of the trolley. When the interlock means is in the release position, the loading machine is suspended like a pendulum. This arrangement facilitates its entrance into the cooling channel and permits sufficient displacement of the lower end of the machine so as to overcome any slight misalignment caused by imperfect positioning of the trolley over the reactor. (F.S.A.)

23781 STEAM GENERATOR FOR A NUCLEAR POWER PLANT. (to Siemens-Schukertwerke AG). British Patent 1,064,504. Apr. 5, 1967. Priority date Aug. 11, 1964, Germany.

A design is given for a superheater facility for a power reactor. The superheater is included inside the pressure vessel and has inlet headers connected to the water conduit outside the pressure vessel. Outlet headers are also provided for connecting the superheater to the live steam conduit outside the pressure vessel. (M.L.S.)

23782 IMPROVEMENTS IN CHARGE-DISCHARGE MACHINES FOR NUCLEAR REACTORS. (to EURATOM). French Patent 1,431,366. Jan. 31, 1966. Priority date Apr. 6, 1964, Great Britain.

The charge machine is situated within a pressure vessel having a passage in the top therein, through which the machine can be introduced for operation. The machine comprises a housing arranged in such a way as to extend into and through the passage. Within the housing a track for a charging trolley is mounted by means of a hinge connection. It is pivotable about the connection into an unfolded position. A track extension is mounted by another connection on the track so as to be pivotable between positions in which the extension lies co-extensive with the track in the folded position or to form an extension thereof in the unfolded position. Actuating means are provided to unfold the track extension in response to pivotal movement of the track about the hinged connection. (IIB)

23783 IMPROVED MEANS FOR PROVIDING A FLUID TIGHT SEAL BETWEEN TWO ORGANS. (to Flight Refuelling Ltd.). French Patent 1,428,268. Jan. 3, 1966. Priority date Mar. 5, 1964, Great Britain.

A fluid-tight seal is provided between a metal acess tube of a nuclear reactor and the plug for closing the access tube. The plug is formed with a longitudinally extending lip which engages a co-operating surface in the bore of the access tube. The external surface of the lip or the co-operating surface are cylindrical and the other of the surfaces are tapered, so that its initial maximum and minimum radial dimensions are respectively greater and smaller than the radius of the cylindrical surface. When the plug is inserted downwardly into the access tube the edge of the lip engages the co-operating surface of the bore slightly before appropriated locking members come into register with corresponding locking grooves. Consequently, the edge of the lip is slightly compressed by the final downward movement of the plug, and an interference fit is produced, which results in a fluid-tight seal. (IIB)

GENERAL

23784 (ACRH-26, pp 36-41) EFFECT OF IONIC STRENGTH UPON THE HEMOLYSIS OF PAROXYSMAL NOCTURNAL HEMOGLOBINURIA ERYTHROCYTES. Yachnin, S. (Argonne Cancer Research Hospital, Chicago, Ill.).

The hemolysis of erythrocytes from patients with paroxysmal nocturnal hemoglobinuria is discussed. Results of experiments are reported that indicate that low ionic strength of the erythrocytes enhances hemolysis. (C.H.)

23785 (ACRH-26, pp 42-51) IMMUNOLOGIC COMPETENCE OF THYMECTOMIZED RATS TO SEVERAL SOLUBLE AND PARTICULATE ANTIGENS. Pinnas, J. L.; Fitch, F. W. (Argonne Cancer Research Hospital, Chicago, Ill.).

Studies on the immunologic competence of thymectomized rats of various ages to several soluble and particulate antigens suggested that immunological maturity is not reached simultaneously for all antigens. Neonatal thymectomy apparently impaired antibody formation to a greater extent in systems that reach maturity at an older age. (C.H.)

23786 (AERE-R-5358) IMPROVING PDP8 DISPLAY RATES BY HARDWARE. Best, G. C. (Atomic Energy Research Establishment, Harwell (England)). Jan. 1967. 9p. Dep. mn. CFSTI $3.00 cy, $0.65 mn. HMSO 1s. 9d.

A register unit is described which allows rapid extraction of display data from a PDP8 computer used as an analyser with 1½ words (18 bits) per channel. This technique is compared with direct program methods, and is shown to result in substantial increase in display rates. (auth)

23787 (BNL-994) ANNUAL REPORT, JULY 1, 1966. (Brookhaven National Lab., Upton, N. Y.). Contract AT(30-2)-Gen-16. 254p. Dep. mn. CFSTI $3.00 cy, $0.65 mn.

Separate abstracts were prepared for eight of the ten sections included in the report. Those sections for which no abstracts were prepared are concerned with laboratory service and administration. (J.R.D.)

For abstracts of individual sections see: 21963, 22188, 22233, 22477, 23314, 23327, 23360, and 23710.

23788 (COO-1493-10) INVESTIGATIONS IN INTEGER LINEAR PROGRAMMING BY DIRECT SEARCH METHODS. Drebes, C.; Cooper, L. (Washington Univ., St. Louis, Mo. Dept. of Applied Mathematics and Computer Sciences). 1966. Contract AT-(11-1)-1493. 68p. Dep. mn. CFSTI $3.00 cy, $0.65 mn.

A direct search technique is discussed for solving integer linear programming problems. A detailed description of the method is also presented. (B.G.D.)

23789 (COO-1493-11) TEST PROBLEMS FOR NONLINEAR PROGRAMMING ALGORITHMS. Weis, M.; Cooper, L. (Washington Univ., St. Louis, Mo. Dept. of Applied Mathematics and Computer Sciences). Jan. 1967. Contract AT(11-1)-1493. 67p. Dep. mn. CFSTI $3.00 cy, $0.65 mn.

Two methods are considered for generating test problems for nonlinear programming algorithms. The first method generates problems with a separable nonlinear objective function and linear constraints, so that there is a maximum of $(k-2)^n$ optimal points, where n represents the number of variables, and k is the degree of each of the polynomials in the separate objective function. The second method constructs problems so that both the concave objective function and the constraints are nonlinear. (B.G.D.)

23790 (GA-7164(Pt.1)) ON STABLE METHODS OF MATRIX FACTORIZATION FOR BLOCK-TRI-DIAGONAL MATRICES. PART 1. GENERAL METHODS AND THEOREMS. Froehlich, Reimar (General Dynamics Corp., San Diego, Calif. General Atomic Div.). Oct. 31, 1966. Contract AT(04-3)-167. 26p. Dep. mn. CFSTI $3.00 cy, $0.65 mn.

For the solution of a system of linear equations with a block-tri-diagonal coefficient matrix the method most widely in use is a direct generalization of the forward elimination-backward substitution method for tri-diagonal matrices. The matrix elements are simply replaced by block-submatrices. If the block-submatrices are all of the same order the reconditioning method, also known as the stabilized march out technique, has been proposed for some applications. Both methods are described and discussed quite generally. Necessary and sufficient conditions for the applicability of both methods, the conventional forward elimination-backward substitution method and the reconditioning method, are derived. Moreover, it is proved that the forward elimination-backward substitution method for block-tri-diagonal matrices is a special case of the reconditioning method. Finally, two iterative improvement techniques for the solution of linear equations and matrix inversions are discussed, and sufficient convergence conditions are derived. (auth)

23791 (IS-T-145) DIFFERENTIAL CAPACITY OF THE ELECTRICAL DOUBLE LAYER AT THE SILVER IODIDE-AQUEOUS SOLUTION INTERFACE. Barshatky, David Morton (Ames Lab., Iowa). Feb. 1967. Contract W-7405-eng-82. 106p. Dep. mn. CFSTI $3.00 cy, $0.65 mn.

Thesis.

An impedance bridge was used to determine the equivalent series capacitance C_V and resistance R_V for the silver iodide aqueous solution system. An AgI electrode in contact with an aqueous potassium nitrate solution containing a very dilute concentration of Ag^+ and I^- ions served as the system. A cell potential range of about 420 millivolts was used at KNO_3 concentrations of 0.1, 0.01, and 0.001 N. The C_V and R_V values at a given potential and electrolyte concentration was determined in a frequency range from 256 to 9,168 cps. Several electrodes of varying AgI thickness were studied to check the consistency of the results. An electrical analog circuit was proposed for the interface which was consistent with known properties of this interface and which adequately represented the dependence of C_V and R_V on frequency and potential over the ranges of frequency and potential studied. It was shown that the frequency dependencies of both C_V and R_V are due to distributed capacitances in the pores of AgI. This effect can be described by tapered RC transmission lines connected in parallel. The equivalent capacitance and resistance of one line represents the impedance in one pore. The equivalent capacitance C_P and resistance R_P of the parallel transmission lines is in parallel with the differential capacitance C_D of the double layer associated with the flat portion of the AgI. The resulting impedance is in series with both the series equivalent capacitance C′ and resistance R′ of solid AgI and the solution resistance. Capacitance C′ arises from space charges of defects in the AgI. By setting the value of the AgI double layer capacity equal to that for the mercury-aqueous sodium fluoride solution interface at the zero point of charge at 0.001 N solution the area of the flat portion of the AgI electrode is determined, and hence the AgI double layer capacity at any potential and electrolyte concentration. The double layer capacity values agree very well with those of Agar around the zero point of charge at various electrolyte concentrations. Whereas Agar's values decrease slightly at high negative potentials, increased values in this potential range were observed. (auth)

23792 (LA-3659) ELECTRONIC SCALE FOR MEASURING MASS FLOW. Rupert, George N. (Los Alamos Scientific Lab., N. Mex.). Jan. 20, 1967. Contract W-7405-eng-36. 8p. Dep. mn. CFSTI $3.00 cy, $0.65 mn.

An electronic scale which measures small rates of mass flow ($\sim 1.5 \times 10^{-4}$ lb/sec) from a large gross weight (250 lb) is described. Four meters indicate the gross weight of the sample and container, sample weight loss, rate of weight loss, and deviation of rate of weight loss from a preset desired rate. In operation, a semiconductor load cell senses the gross weight. The output of the load cell is amplified to produce an analog signal proportional to the gross weight. This signal is differentiated electronically to produce the rate of mass flow information in units of 0.1 lb/10 min. An additional output circuit shows the deviation of the rate of mass flow from a present desired rate. (auth)

23793 (NVO-90-1) AN ECOLOGICAL RECONNAISSANCE OF JOHNSTON ISLAND AND THE EFFECTS OF DREDGING. Annual Report. Technical Report No. 5. Brock, Vernon E.; Jones, Robert S.; Helfrich, Philip (Hawaii Marine Lab., Honolulu). Jan. 1965. Contract AT(26-1)-90. 96p. Dep. mn. CFSTI $3.00 cy, $0.65 mn.

23794 (NYO-3503-3) A STUDY OF AGGREGATE ICE FORMATION AS A METHOD OF CONCENTRATING IMPURITIES IN AQUEOUS SOLUTIONS. Final Report. Waller, Robert (Johns Hopkins Univ., Baltimore, Md. Dept. of Environmental Engineering Science). Mar. 1967. Contract AT(30-1)-3503. 163p. Dep. mn. CFSTI $3.00 cy, $0.65 mn.

Thesis.

The variability and control of impurity inclusion in aggregate ice was investigated. From a consideration of theory developed in metallurgy and applied physics, three major external variables were postulated: the gross rate of freezing; the concentration of solute; and the thickness of the mass boundary layer adjacent to the advancing ice wall. The effects of these variables were studied

by freezing sodium chloride solutions, using both batch and continuous rotary drum techniques. Results showed that when these three variables were controlled excellent solute separation could be achieved by both techniques. High freezing rates caused thin crystals with consequent brine inclusion in the ice aggregate, thought to be due to the anisotropy in growth velocity between the two main growth directions. When the initial concentration of the solutions was increased in successive runs the amount of brine inclusion behaved as a step function. Above and below a critical range of solute concentrations the relative amount of entrapped impurity was fairly constant, although at different levels. The critical concentration range was characterized by a rapid increase in brine entrapment accompanied by a sudden change in crystal size. It was found that there was a maximum concentration boundary layer thickness that could be tolerated before detrimental effects occurred. A wiped film technique was developed, which proved highly effective for boundary layer control. The time available for the development of this boundary layer was found to be a determining parameter for separation efficiency. The rotary drum process, when properly controlled, proved to be an efficient method of continuous solute separation, and therefore, can be considered applicable for large scale use. (auth)

23795 (NYO-3697-17) OHIO AMISH DIRECTORY: HOLMES COUNTY AND VICINITY. 1965 Edition. (Johns Hopkins Univ., Baltimore, Md. Div. of Medical Genetics). Contract AT(30-1)-3697. 271p. Dep. mn. CFSTI $3.00 cy, $0.65 mn.

A listing of the Amish residents of Holmes County and vicinity is presented. Extensive maps are provided. A statistical section containing lists of parochial schools, vocational schools, and other information is included. (H.L.W.)

23796 (ORNL-P-2960) EFFECT OF LOW COST POWER ON WATER TRANSMISSION BY PIPELINE. Burwell, C. C. (Oak Ridge National Lab., Tenn.). [1966]. Contract W-7405-eng-26. 11p. (CONF-670508-2). Dep. CFSTI.

From International Conference on Water for Peace, Washington, D. C.

Projections of low cost desalted water are based on low energy (both heat and power) cost estimates from nuclear reactors. The cost estimates do not include the cost of delivering the water to the distribution reservoir. An analysis is made of the cost of conveying water by pipelines. It was found that pipeline water conveyance costs are not strongly affected by power costs and that desalted water may be lifted 1000 ft using power costing 2 mills/kWh or about 1.3¢/1000 gal. (F.S.)

23797 (ORNL-TM-1795) "BIG HOOP" AND "LITTLE HOOP": TWO "PETER T. HOOPER" ROUTINES FOR CHECKING THE DATA BREAK ON A PDP-8. Rust, B. W.; Burrus, W. R. (Oak Ridge National Lab., Tenn.). Mar. 22, 1967. Contract W-7405-eng-26. 31p. Dep. mn. CFSTI $3.00 cy, $0.65 mn.

Two routines were written to check the data break for the PDP-8. LITTLE HOOP flickers for each event a dot on the oscilloscope with x and y coordinates equal to any two of the four signals for that event. BIG HOOP does the same but, unlike LITTLE HOOP which requires the user to specify which two signals he wants plotted at the start of the program, BIG HOOP also contains a command program COMMD, which allows the user to change the signal being plotted along each axis by typing in changes from the keyboard. COMMD also can serve as a prototype for more complex and powerful command routines which could be used to give the experimenter more flexibility in controlling what the computer does during the experiment. (auth)

23798 (ORNL-TM-1805) "PUT-5" AND "TAKE-5": TWO MAGNETIC TAPE SYSTEMS ROUTINES FOR THE PDP-8. Rust, B. W.; Burrus, W. R. (Oak Ridge National Lab., Tenn.). Mar. 22, 1967. Contract W-7405-eng-26. 15p. Dept. mn. CFSTI $4.00 cy, $0.65 mn.

Two magnetic tape systems routines were written to provide fast input of programs or data to a PDP-8 computer from a DEC type 580 tape transport. PUT-5 is used to create systems tapes containing the user's programs and TAKE-5 is used to read the programs into the computer from such systems tapes. (auth)

23799 (SC-R-66-997) SOME COMMENTS ON THE AERODYNAMIC CHARACTERISTICS OF THE TOMAHAWK SOUNDING ROCKET. Curry, Warren H.; Uselton, James C. (Sandia Corp., Albuquerque, N. Mex.). Mar. 1967. Contract AT(29-1)-789. 15p. (CONF-670209-1). Dep. mn. CFSTI $3.00 cy, $0.65 mn.

From AIAA Sounding Rocket Vehicle Technology Specialist Conference, Williamsburg, Va.

The Tomahawk sounding rocket, when flown as the second stage of the Nitehawk 9 system, occasionally exhibits a dynamic instability after motor burnout. This instability, which is not related to roll–pitch resonance or roll–pitch lockin, causes extra-atmospheric coning motions of a magnitude several times that which would result from the normal effect of the dynamic pressure gradient. The research being conducted to explain this phenomenon includes studies of the effects of aeroelasticity, and the cross-coupling moments produced by the Magnus effect and asymmetric lee-side vorticity. Analyses of flight test data have yielded information on the extent of vehicle bending, and on the magnitude of the cross-coupling moments. Wind tunnel tests and theoretical studies have provided further information on the cross-coupling contribution. It has not yet been resolved as to which effect predominates. Although the number of cases of adverse coning motion appears to be greater with structurally more flexible systems, it remains to be determined whether the coning is caused primarily by the relaxing of the static moment during bending or by the aggravation of detrimental cross-coupling moments introduced at burnout by flexing and other perturbations. (auth)

23800 (SC-R-67-1044) HUMAN FACTORS APPROACH TO REDUCING PRODUCTION ERRORS. Swain, Alan D. (Sandia Corp., Albuquerque, N. Mex.). Feb. 1967. Contract AT(29-1)-789. 7p. Dep. mn. CFSTI $3.00 cy, $0.65 mn.

Average inspection error rates among production workers are discussed. A possible solution for reducing errors is suggested. The analytical approach to worker errors is considered. (H.L.W.)

23801 (SC-R-67-1052) TABLES FOR THE SQUARE ROOT OF COMPLEX NUMBERS. Harrison, Charles W. Jr.; Aronson, Eugene A. (Sandia Corp., Albuquerque, N. Mex.). Jan. 1967. Contract AT(29-1)-789. 138p. Dep. mn. CFSTI $3.00 cy, $0.65 mn.

The propagation constant of an electromagnetic field existing in a dissipative medium is obtained by taking the square root of a complex number. In order to take the drudgery out of the numerical determination of this constant, the tables presented herein were prepared. Certain useful relations between the real and imaginary parts of the square roots of the square of the propagation constant are developed. The procedure to follow in evaluating $\sqrt{\pm a \pm jb}$ from the tables is described in detail. (auth)

23802 (SC-R-67-1060) SANDIA CORPORATION REPRINTS, MONOGRAPHS, AND RESEARCH COLLOQUIA: TITLE LIST, 1963–1966. (Sandia Corp., Albuquerque, N. Mex.). Mar. 1967. Contract AT(29-1)-789. 76p. Dep. mn. CFSTI $3.00 cy, $0.65 mn.

A title list is presented which includes Sandia Corporation (SC) series R reports published during the years 1963 through 1966. The R series includes reprints of published articles and speeches; monographs or treatises issued by Sandia on specialized topics; research colloquium papers and symposium collections of interest to the public; bibliographies of more than local interest; and other technical papers printed for release to the public. (B.G.D.)

23803 (SC-RR-67-14) PRODUCTION OF LOW CONCENTRATION PARTICULATE AEROSOLS BY A SONIC DISSEMINATOR TECHNIQUE. Dugan, Virgil L. (Sandia Corp., Albuquerque, N. Mex.). Dec. 1966. Contract AT(29-1)-789. 17p. Dep. mn. CFSTI $3.00 cy, $0.65 mn.

A technique is described by which an ultrasonic vibrator may be used to produce particulate aerosols with concentration levels below 5000 particles per cubic foot in an enclosed volume with good repeatability. (auth)

23804 (SC-TM-67-144) DIGITAL COMPUTER PROGRAM FOR THE SIMULATION OF FILTERS AND OTHER TRANSFER FUNCTIONS. Bjork, D. R. (Sandia Corp., Albuquerque, N. Mex.). Apr. 1967. Contract AT(29-1)-789. 45p. Dep. mn. CFSTI $3.00 cy, $0.65 mn.

The filter and transfer function simulator computer program is approached, using a state-variable model for derivation of the response of a given transfer function. The simulator will derive the transfer functions for Butterworth, Chebyshev, Bessel, and all transitional cases of the previous three filters. Simulation is done with fixed-frequency samples. The user needs no computer experience, and must provide only options and parameters. (auth)

23805 (SCL-CR-66-74) TEST DEVELOPMENT AND CYLINDER TESTS. Final Summary Report. Salzman, P. K.; Weatherill, W. T. (Aerojet-General Corp., Downey, Calif. Research Div.). Mar. 1967. Contract AT(29-1)-789. 52p. CFSTI $3.00 cy, $0.65 mn.

For Sandia Corp., Livermore, Calif.

A technique was developed for impulse loading by means of explosively driven curved flyer plates. This technique utilizes a constant thickness flyer plate. Initially, the flyer plate configuration was to remain constant during flight. Techniques were developed for both the constant shape and radially collapsing flyer plates. A technique with a varying thickness flyer plate was studied. The following conclusions were reached: the velocity of the aluminum flyer plate could be obtained in the desired range of 225 to 4500 ips by use of a combination of Detasheet explosive,

foam attenuator, and steel buffer plate; explosively driven, high-velocity particles of glass will cause an aluminum flyer plate to spall off a steel buffer plate. The velocity of the flyer plates can be varied by changing the thickness of the buffer plate; the angle to obtain simultaneous impact of the explosively driven (Detasheet C-1) high-velocity glass particles is 10°. Detasheet C-1 could not be surface initiated by the impact of explosively driven high-velocity glass particles; the shock wave penetration velocity in open pore polyester foam of 2 lb/ft^3 density was determined; the polyester foam (density = 2 lb/ft^3) is compressed and forced ahead of the shock wave; the configuration of the plastic foam attenuator, to obtain simultaneous impact of the shock wave with the buffer plate, was graphically determined; and theoretical studies were performed to determine the shape, position, and hydrodynamic parameters of the various waves in the buffer and flyer plates as well as the shape of the buffer and flyer plates required to impart a cosine distributed shock impulse to a cylindrical target, using a flyer plate. (auth)

23806 (SCL-CR-67-167) CONVERSATIONAL APT: A REPORT ON THE FEASIBILITY OF IMPLEMENTING APT AS AN ON-LINE INTERACTIVE SYSTEM. Final Report. Horning, D. B. (Control Data Corp., Palo Alto, Calif.). Apr. 1967. Contract AT(29-1)-789. 101p. Dep. CFSTI.

For Sandia Corp., Livermore, Calif.

The feasibility of implementing APT III in conversational mode on a Control Data Corporation 3600/3800 computer. Topics include design objectives, conversational design, reference specifications, the whole system, the APT manager (APTMGR), flow of information through the conversational APT complex, the APT execution complex, editing complex, retrieval and control complex, and system implementation. (B.G.D.)

23807 (SCL-RR-66-97) EQUILIBRIUM COMPOSITION AND SHOCK-WAVE CHARACTERISTICS OF FREON C-318. Emery, A. F. (Sandia Corp., Livermore, Calif. Washington Univ., Seattle). Mar. 1967. Contract AT(29-1)-789. 70p. Dep. mn. CFSTI $3.00 cy, $0.65 mn.

A discussion of the theoretical behavior of Freon C-318 in an aerodynamic shock tube with a stationary test model is based on an equilibrium composition determined by numerical calculations. Pressure calculations indicate that the ideal gas-flow properties would be very little affected by the decomposition of the gas which occurs behind the shock wave. (auth)

23808 (UCID-15100) DETERMINATION OF TRACE CHLORINE IN FLUOROELASTOMERS. General Chemistry Technical Note No. 237. Lim, Robert (California Univ., Livermore. Lawrence Radiation Lab.). Apr. 4, 1967. Contract W-7405-eng-48. 6p. Dep. mn. CFSTI $3.00 cy, $0.65 mn.

A method for determining trace chlorine in fluoroelastomers is presented. The fluoroelastomer, with paraffin added as fuel, was burned in a platinum-lined oxygen bomb containing sodium hydroxide absorbing solution. This solution was then titrated with mercuric nitrate, with s-diphenylcarbazone used as the indicator. (auth)

23809 (UCID-15109) EXPERIMENTAL STUDIES ON THE ADSORPTION OF MOLECULAR IODINE ON SOOT. Ackerman, F. J.; Kay, C. (California Univ., Livermore. Lawrence Radiation Lab.). Feb. 9, 1967. Contract W-7405-eng-48. 15p. Dep. mn. CFSTI $3.00 cy, $0.65 mn.

Measurements were made of the adsorption of airborne molecular iodine on soot produced by burning acetylene, latex tubing, and automobile tire rubber. Soot from latex tubing and rubber tires adsorbed approximately 90% of the iodine over a wide range of soot and iodine concentrations when the contact time was 0.6 minutes or greater and the I_2/soot ratio was less than 0.0062 gram/gram. (auth)

23810 (UCRL-50219) PROCEDURE FOR INTERPOLATING BIVARIANT DATA INFLUENCED BY RANDOM ERROR. Van Sant, J. H. (California Univ., Livermore. Lawrence Radiation Lab.). Mar. 31, 1967. Contract W-7405-eng-48. 12p. Dep. CFSTI.

Suppose there exists a table of data (X_j, Y_j), j = 1, 2, . . ., in which the dependent variable is in part probabilistic (i.e., it contains some random error). The symbol X is referred to as the independent variable and the symbol Y as the variable dependent on X. Let X^* be the value of X at which it is desired to estimate a value of Y to be called Y^*. A method for determining Y^* from an optimum number of local data points is described. (B.G.D.)

23811 INTERNATIONAL COOPERATION IN STANDARDIZATION OF IONIZING RADIATIONS UNDER THE AUSPICES OF THE INTERNATIONAL BUREAU OF WEIGHTS AND MEASURES. Yura, Osamu. Denki Shikensho Iho, 30: 1035-40(Dec. 1966). (In Japanese).

An outline of the cooperative activities internationally performed in the field of the standardization of ionizing radiation during the last decade is given based on the reports of the Consultative Committee for the Standards of Measurement of Ionizing Radiations presented to the International Committee of Weights and Measures. (tr-auth)

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The fuel tube of a nuclear reactor passes through a sleeve mounted in the shield. The sleeve has a conical portion and a cylindrical portion. The conical portion extends through the inner half of the shield and loosely receives the fuel tube, while the cylindrical portion of the sleeve extends through the outer half of the shield and fairly closely fits the fuel tube without being tight thereon. Just beyond the sleeve, the fuel tube has another sleeve which is fixed therein. This second sleeve can move out of abutment with the first one, if the fuel tube moves because of the thermal expansion. When differential expansion of the reactor core and the shield causes the fuel tube to be moved transversely of its axis, the conical portion of the sleeve permits such movement. (I.I.B.)

23779 LIQUID MODERATED NUCLEAR REACTOR. (to Societe Anglo-Belge Vulcain S.A.). French Patent 1,434,936. Mar. 7, 1966. Priority date Nov. 19, 1962, Great Britain.

The reactor is provided with a cellular core lattice having a series of slots therein arranged sequentially across the core, so as to define a fuel free slab shaped zone penetrating the core. A number of slot shaped control absorbers are movable in the fuel free zones and are hollow and open ended to enclose moderator when inserted into the fuel free zones. (I.I.B.)

23780 DEVICE FOR LOADING ATOMIC REACTORS. Kumpf, H.; Weber, R.; Ropers, J.; Gallwas, J. (to Siemens-Schuckertwerke Aktiengesellschaft). Canadian Patent 751,562. Jan. 24, 1967. Priority date June 30, 1961, Germany.

A trolley supported above the reactor is adapted to position the machine above the cooling channel and is provided with a retaining member attached to the undercarriage of the trolley. When the interlock means is in the release position, the loading machine is suspended like a pendulum. This arrangement facilitates its entrance into the cooling channel and permits sufficient displacement of the lower end of the machine so as to overcome any slight misalignment caused by imperfect positioning of the trolley over the reactor. (F.S.A.)

23781 STEAM GENERATOR FOR A NUCLEAR POWER PLANT. (to Siemens-Schukertwerke AG). British Patent 1,064,504. Apr. 5, 1967. Priority date Aug. 11, 1964, Germany.

A design is given for a superheater facility for a power reactor. The superheater is included inside the pressure vessel and has inlet headers connected to the water conduit outside the pressure vessel. Outlet headers are also provided for connecting the superheater to the live steam conduit outside the pressure vessel. (M.L.S.)

23782 IMPROVEMENTS IN CHARGE-DISCHARGE MACHINES FOR NUCLEAR REACTORS. (to EURATOM). French Patent 1,431,366. Jan. 31, 1966. Priority date Apr. 6, 1964, Great Britain.

The charge machine is situated within a pressure vessel having a passage in the top therein, through which the machine can be introduced for operation. The machine comprises a housing arranged in such a way as to extend into and through the passage. Within the housing a track for a charging trolley is mounted by means of a hinge connection. It is pivotable about the connection into an unfolded position. A track extension is mounted by another connection on the track so as to be pivotable between positions in which the extension lies co-extensive with the track in the folded position or to form an extension thereof in the unfolded position. Actuating means are provided to unfold the track extension in response to pivotal movement of the track about the hinged connection. (IIB)

23783 IMPROVED MEANS FOR PROVIDING A FLUID TIGHT SEAL BETWEEN TWO ORGANS. (to Flight Refuelling Ltd.). French Patent 1,428,268. Jan. 3, 1966. Priority date Mar. 5, 1964, Great Britain.

A fluid-tight seal is provided between a metal acess tube of a nuclear reactor and the plug for closing the access tube. The plug is formed with a longitudinally extending lip which engages a co-operating surface in the bore of the access tube. The external surface of the lip or the co-operating surface are cylindrical and the other of the surfaces are tapered, so that its initial maximum and minimum radial dimensions are respectively greater and smaller than the radius of the cylindrical surface. When the plug is inserted downwardly into the access tube the edge of the lip engages the co-operating surface of the bore slightly before appropriated locking members come into register with corresponding locking grooves. Consequently, the edge of the lip is slightly compressed by the final downward movement of the plug, and an interference fit is produced, which results in a fluid-tight seal. (IIB)

GENERAL

23784 (ACRH-26, pp 36-41) EFFECT OF IONIC STRENGTH UPON THE HEMOLYSIS OF PAROXYSMAL NOCTURNAL HEMOGLOBINURIA ERYTHROCYTES. Yachnin, S. (Argonne Cancer Research Hospital, Chicago, Ill.).

The hemolysis of erythrocytes from patients with paroxysmal nocturnal hemoglobinuria is discussed. Results of experiments are reported that indicate that low ionic strength of the erythrocytes enhances hemolysis. (C.H.)

23785 (ACRH-26, pp 42-51) IMMUNOLOGIC COMPETENCE OF THYMECTOMIZED RATS TO SEVERAL SOLUBLE AND PARTICULATE ANTIGENS. Pinnas, J. L.; Fitch, F. W. (Argonne Cancer Research Hospital, Chicago, Ill.).

Studies on the immunologic competence of thymectomized rats of various ages to several soluble and particulate antigens suggested that immunological maturity is not reached simultaneously for all antigens. Neonatal thymectomy apparently impaired antibody formation to a greater extent in systems that reach maturity at an older age. (C.H.)

23786 (AERE-R-5358) IMPROVING PDP8 DISPLAY RATES BY HARDWARE. Best, G. C. (Atomic Energy Research Establishment, Harwell (England)). Jan. 1967. 9p. Dep. mn. CFSTI $3.00 cy, $0.65 mn. HMSO 1s. 9d.

A register unit is described which allows rapid extraction of display data from a PDP8 computer used as an analyser with 1½ words (18 bits) per channel. This technique is compared with direct program methods, and is shown to result in substantial increase in display rates. (auth)

23787 (BNL-994) ANNUAL REPORT, JULY 1, 1966. (Brookhaven National Lab., Upton, N. Y.). Contract AT(30-2)-Gen-16. 254p. Dep. mn. CFSTI $3.00 cy, $0.65 mn.

Separate abstracts were prepared for eight of the ten sections included in the report. Those sections for which no abstracts were prepared are concerned with laboratory service and administration. (J.R.D.)

For abstracts of individual sections see: 21963, 22188, 22233, 22477, 23314, 23327, 23360, and 23710.

23788 (COO-1493-10) INVESTIGATIONS IN INTEGER LINEAR PROGRAMMING BY DIRECT SEARCH METHODS. Drebes, C.; Cooper, L. (Washington Univ., St. Louis, Mo. Dept. of Applied Mathematics and Computer Sciences). 1966. Contract AT-(11-1)-1493. 68p. Dep. mn. CFSTI $3.00 cy, $0.65 mn.

A direct search technique is discussed for solving integer linear programming problems. A detailed description of the method is also presented. (B.G.D.)

23789 (COO-1493-11) TEST PROBLEMS FOR NONLINEAR PROGRAMMING ALGORITHMS. Weis, M.; Cooper, L. (Washington Univ., St. Louis, Mo. Dept. of Applied Mathematics and Computer Sciences). Jan. 1967. Contract AT(11-1)-1493. 67p. Dep. mn. CFSTI $3.00 cy, $0.65 mn.

Two methods are considered for generating test problems for nonlinear programming algorithms. The first method generates problems with a separable nonlinear objective function and linear constraints, so that there is a maximum of $(k-2)^n$ optimal points, where n represents the number of variables, and k is the degree of each of the polynomials in the separate objective function. The second method constructs problems so that both the concave objective function and the constraints are nonlinear. (B.G.D.)

23790 (GA-7164(Pt.1)) ON STABLE METHODS OF MATRIX FACTORIZATION FOR BLOCK-TRI-DIAGONAL MATRICES. PART 1. GENERAL METHODS AND THEOREMS. Froehlich, Reimar (General Dynamics Corp., San Diego, Calif. General Atomic Div.). Oct. 31, 1966. Contract AT(04-3)-167. 26p. Dep. mn. CFSTI $3.00 cy, $0.65 mn.

For the solution of a system of linear equations with a block-tri-diagonal coefficient matrix the method most widely in use is a direct generalization of the forward elimination-backward substitution method for tri-diagonal matrices. The matrix elements are simply replaced by block-submatrices. If the block-submatrices are all of the same order the reconditioning method, also known as the stabilized march out technique, has been proposed for some applications. Both methods are described and discussed quite generally. Necessary and sufficient conditions for the applicability of both methods, the conventional forward elimination-backward substitution method and the reconditioning method, are derived. Moreover, it is proved that the forward elimination-backward substitution method for block-tri-diagonal matrices is a special case of the reconditioning method. Finally, two iterative improvement techniques for the solution of linear equations and matrix inversions are discussed, and sufficient convergence conditions are derived. (auth)

23791 (IS-T-145) DIFFERENTIAL CAPACITY OF THE ELECTRICAL DOUBLE LAYER AT THE SILVER IODIDE-AQUEOUS SOLUTION INTERFACE. Barshatky, David Morton (Ames Lab., Iowa). Feb. 1967. Contract W-7405-eng-82. 106p. Dep. mn. CFSTI $3.00 cy, $0.65 mn.

Thesis.

An impedance bridge was used to determine the equivalent series capacitance C_V and resistance R_V for the silver iodide aqueous solution system. An AgI electrode in contact with an aqueous potassium nitrate solution containing a very dilute concentration of Ag^+ and I^- ions served as the system. A cell potential range of about 420 millivolts was used at KNO_3 concentrations of 0.1, 0.01, and 0.001 N. The C_V and R_V values at a given potential and electrolyte concentration was determined in a frequency range from 256 to 9,168 cps. Several electrodes of varying AgI thickness were studied to check the consistency of the results. An electrical analog circuit was proposed for the interface which was consistent with known properties of this interface and which adequately represented the dependence of C_V and R_V on frequency and potential over the ranges of frequency and potential studied. It was shown that the frequency dependencies of both C_V and R_V are due to distributed capacitances in the pores of AgI. This effect can be described by tapered RC transmission lines connected in parallel. The equivalent capacitance and resistance of one line represents the impedance in one pore. The equivalent capacitance C_P and resistance R_P of the parallel transmission lines is in parallel with the differential capacitance C_D of the double layer associated with the flat portion of the AgI. The resulting impedance is in series with both the series equivalent capacitance C′ and resistance R′ of solid AgI and the solution resistance. Capacitance C′ arises from space charges of defects in the AgI. By setting the value of the AgI double layer capacity equal to that for the mercury-aqueous sodium fluoride solution interface at the zero point of charge at 0.001 N solution the area of the flat portion of the AgI electrode is determined, and hence the AgI double layer capacity at any potential and electrolyte concentration. The double layer capacity values agree very well with those of Agar around the zero point of charge at various electrolyte concentrations. Whereas Agar's values decrease slightly at high negative potentials, increased values in this potential range were observed. (auth)

23792 (LA-3659) ELECTRONIC SCALE FOR MEASURING MASS FLOW. Rupert, George N. (Los Alamos Scientific Lab., N. Mex.). Jan. 20, 1967. Contract W-7405-eng-36. 8p. Dep. mn. CFSTI $3.00 cy, $0.65 mn.

An electronic scale which measures small rates of mass flow ($\sim 1.5 \times 10^{-4}$ lb/sec) from a large gross weight (250 lb) is described. Four meters indicate the gross weight of the sample and container, sample weight loss, rate of weight loss, and deviation of rate of weight loss from a preset desired rate. In operation, a semiconductor load cell senses the gross weight. The output of the load cell is amplified to produce an analog signal proportional to the gross weight. This signal is differentiated electronically to produce the rate of mass flow information in units of 0.1 lb/10 min. An additional output circuit shows the deviation of the rate of mass flow from a present desired rate. (auth)

23793 (NVO-90-1) AN ECOLOGICAL RECONNAISSANCE OF JOHNSTON ISLAND AND THE EFFECTS OF DREDGING. Annual Report. Technical Report No. 5. Brock, Vernon E.; Jones, Robert S.; Helfrich, Philip (Hawaii Marine Lab., Honolulu). Jan. 1965. Contract AT(26-1)-90. 96p. Dep. mn. CFSTI $3.00 cy, $0.65 mn.

23794 (NYO-3503-3) A STUDY OF AGGREGATE ICE FORMATION AS A METHOD OF CONCENTRATING IMPURITIES IN AQUEOUS SOLUTIONS. Final Report. Waller, Robert (Johns Hopkins Univ., Baltimore, Md. Dept. of Environmental Engineering Science). Mar. 1967. Contract AT(30-1)-3503. 163p. Dep. mn. CFSTI $3.00 cy, $0.65 mn.

Thesis.

The variability and control of impurity inclusion in aggregate ice was investigated. From a consideration of theory developed in metallurgy and applied physics, three major external variables were postulated: the gross rate of freezing; the concentration of solute; and the thickness of the mass boundary layer adjacent to the advancing ice wall. The effects of these variables were studied

by freezing sodium chloride solutions, using both batch and continuous rotary drum techniques. Results showed that when these three variables were controlled excellent solute separation could be achieved by both techniques. High freezing rates caused thin crystals with consequent brine inclusion in the ice aggregate, thought to be due to the anisotropy in growth velocity between the two main growth directions. When the initial concentration of the solutions was increased in successive runs the amount of brine inclusion behaved as a step function. Above and below a critical range of solute concentrations the relative amount of entrapped impurity was fairly constant, although at different levels. The critical concentration range was characterized by a rapid increase in brine entrapment accompanied by a sudden change in crystal size. It was found that there was a maximum concentration boundary layer thickness that could be tolerated before detrimental effects occurred. A wiped film technique was developed, which proved highly effective for boundary layer control. The time available for the development of this boundary layer was found to be a determining parameter for separation efficiency. The rotary drum process, when properly controlled, proved to be an efficient method of continuous solute separation, and therefore, can be considered applicable for large scale use. (auth)

23795 (NYO-3697-17) OHIO AMISH DIRECTORY: HOLMES COUNTY AND VICINITY. 1965 Edition. (Johns Hopkins Univ., Baltimore, Md. Div. of Medical Genetics). Contract AT(30-1)-3697. 271p. Dep. mn. CFSTI $3.00 cy, $0.65 mn.

A listing of the Amish residents of Holmes County and vicinity is presented. Extensive maps are provided. A statistical section containing lists of parochial schools, vocational schools, and other information is included. (H.L.W.)

23796 (ORNL-P-2960) EFFECT OF LOW COST POWER ON WATER TRANSMISSION BY PIPELINE. Burwell, C. C. (Oak Ridge National Lab., Tenn.). [1966]. Contract W-7405-eng-26. 11p. (CONF-670508-2). Dep. CFSTI.

From International Conference on Water for Peace, Washington, D. C.

Projections of low cost desalted water are based on low energy (both heat and power) cost estimates from nuclear reactors. The cost estimates do not include the cost of delivering the water to the distribution reservoir. An analysis is made of the cost of conveying water by pipelines. It was found that pipeline water conveyance costs are not strongly affected by power costs and that desalted water may be lifted 1000 ft using power costing 2 mills/kWh or about 1.3¢/1000 gal. (F.S.)

23797 (ORNL-TM-1795) "BIG HOOP" AND "LITTLE HOOP": TWO "PETER T. HOOPER" ROUTINES FOR CHECKING THE DATA BREAK ON A PDP-8. Rust, B. W.; Burrus, W. R. (Oak Ridge National Lab., Tenn.). Mar. 22, 1967. Contract W-7405-eng-26. 31p. Dep. mn. CFSTI $3.00 cy, $0.65 mn.

Two routines were written to check the data break for the PDP-8. LITTLE HOOP flickers for each event a dot on the oscilloscope with x and y coordinates equal to any two of the four signals for that event. BIG HOOP does the same but, unlike LITTLE HOOP which requires the user to specify which two signals he wants plotted at the start of the program, BIG HOOP also contains a command program COMMD, which allows the user to change the signal being plotted along each axis by typing in changes from the keyboard. COMMD also can serve as a prototype for more complex and powerful command routines which could be used to give the experimenter more flexibility in controlling what the computer does during the experiment. (auth)

23798 (ORNL-TM-1805) "PUT-5" AND "TAKE-5": TWO MAGNETIC TAPE SYSTEMS ROUTINES FOR THE PDP-8. Rust, B. W.; Burrus, W. R. (Oak Ridge National Lab., Tenn.). Mar. 22, 1967. Contract W-7405-eng-26. 15p. Dept. mn. CFSTI $4.00 cy, $0.65 mn.

Two magnetic tape systems routines were written to provide fast input of programs or data to a PDP-8 computer from a DEC type 580 tape transport. PUT-5 is used to create systems tapes containing the user's programs and TAKE-5 is used to read the programs into the computer from such systems tapes. (auth)

23799 (SC-R-66-997) SOME COMMENTS ON THE AERODYNAMIC CHARACTERISTICS OF THE TOMAHAWK SOUNDING ROCKET. Curry, Warren H.; Uselton, James C. (Sandia Corp., Albuquerque, N. Mex.). Mar. 1967. Contract AT(29-1)-789. 15p. (CONF-670209-1). Dep. mn. CFSTI $3.00 cy, $0.65 mn.

From AIAA Sounding Rocket Vehicle Technology Specialist Conference, Williamsburg, Va.

The Tomahawk sounding rocket, when flown as the second stage of the Nitehawk 9 system, occasionally exhibits a dynamic instability after motor burnout. This instability, which is not related to roll-pitch resonance or roll-pitch lockin, causes extra-atmospheric coning motions of a magnitude several times that which would result from the normal effect of the dynamic pressure gradient. The research being conducted to explain this phenomenon includes studies of the effects of aeroelasticity, and the cross-coupling moments produced by the Magnus effect and asymmetric lee-side vorticity. Analyses of flight test data have yielded information on the extent of vehicle bending, and on the magnitude of the cross-coupling moments. Wind tunnel tests and theoretical studies have provided further information on the cross-coupling contribution. It has not yet been resolved as to which effect predominates. Although the number of cases of adverse coning motion appears to be greater with structurally more flexible systems, it remains to be determined whether the coning is caused primarily by the relaxing of the static moment during bending or by the aggravation of detrimental cross-coupling moments introduced at burnout by flexing and other perturbations. (auth)

23800 (SC-R-67-1044) HUMAN FACTORS APPROACH TO REDUCING PRODUCTION ERRORS. Swain, Alan D. (Sandia Corp., Albuquerque, N. Mex.). Feb. 1967. Contract AT(29-1)-789. 7p. Dep. mn. CFSTI $3.00 cy, $0.65 mn.

Average inspection error rates among production workers are discussed. A possible solution for reducing errors is suggested. The analytical approach to worker errors is considered. (H.L.W.)

23801 (SC-R-67-1052) TABLES FOR THE SQUARE ROOT OF COMPLEX NUMBERS. Harrison, Charles W. Jr.; Aronson, Eugene A. (Sandia Corp., Albuquerque, N. Mex.). Jan. 1967. Contract AT(29-1)-789. 138p. Dep. mn. CFSTI $3.00 cy, $0.65 mn.

The propagation constant of an electromagnetic field existing in a dissipative medium is obtained by taking the square root of a complex number. In order to take the drudgery out of the numerical determination of this constant, the tables presented herein were prepared. Certain useful relations between the real and imaginary parts of the square roots of the square of the propagation constant are developed. The procedure to follow in evaluating $\sqrt{\pm a \pm jb}$ from the tables is described in detail. (auth)

23802 (SC-R-67-1060) SANDIA CORPORATION REPRINTS, MONOGRAPHS, AND RESEARCH COLLOQUIA: TITLE LIST, 1963-1966. (Sandia Corp., Albuquerque, N. Mex.). Mar. 1967. Contract AT(29-1)-789. 76p. Dep. mn. CFSTI $3.00 cy, $0.65 mn.

A title list is presented which includes Sandia Corporation (SC) series R reports published during the years 1963 through 1966. The R series includes reprints of published articles and speeches; monographs or treatises issued by Sandia on specialized topics; research colloquium papers and symposium collections of interest to the public; bibliographies of more than local interest; and other technical papers printed for release to the public. (B.G.D.)

23803 (SC-RR-67-14) PRODUCTION OF LOW CONCENTRATION PARTICULATE AEROSOLS BY A SONIC DISSEMINATOR TECHNIQUE. Dugan, Virgil L. (Sandia Corp., Albuquerque, N. Mex.). Dec. 1966. Contract AT(29-1)-789. 17p. Dep. mn. CFSTI $3.00 cy, $0.65 mn.

A technique is described by which an ultrasonic vibrator may be used to produce particulate aerosols with concentration levels below 5000 particles per cubic foot in an enclosed volume with good repeatability. (auth)

23804 (SC-TM-67-144) DIGITAL COMPUTER PROGRAM FOR THE SIMULATION OF FILTERS AND OTHER TRANSFER FUNCTIONS. Bjork, D. R. (Sandia Corp., Albuquerque, N. Mex.). Apr. 1967. Contract AT(29-1)-789. 45p. Dep. mn. CFSTI $3.00 cy, $0.65 mn.

The filter and transfer function simulator computer program is approached, using a state-variable model for derivation of the response of a given transfer function. The simulator will derive the transfer functions for Butterworth, Chebyshev, Bessel, and all transitional cases of the previous three filters. Simulation is done with fixed-frequency samples. The user needs no computer experience, and must provide only options and parameters. (auth)

23805 (SCL-CR-66-74) TEST DEVELOPMENT AND CYLINDER TESTS. Final Summary Report. Salzman, P. K.; Weatherill, W. T. (Aerojet-General Corp., Downey, Calif. Research Div.). Mar. 1967. Contract AT(29-1)-789. 52p. CFSTI $3.00 cy, $0.65 mn.

For Sandia Corp., Livermore, Calif.

A technique was developed for impulse loading by means of explosively driven curved flyer plates. This technique utilizes a constant thickness flyer plate. Initially, the flyer plate configuration was to remain constant during flight. Techniques were developed for both the constant shape and radially collapsing flyer plates. A technique with a varying thickness flyer plate was studied. The following conclusions were reached: the velocity of the aluminum flyer plate could be obtained in the desired range of 225 to 4500 ips by use of a combination of Detasheet explosive,

foam attenuator, and steel buffer plate; explosively driven, high-velocity particles of glass will cause an aluminum flyer plate to spall off a steel buffer plate. The velocity of the flyer plates can be varied by changing the thickness of the buffer plate; the angle to obtain simultaneous impact of the explosively driven (Detasheet C-1) high-velocity glass particles is 10°. Detasheet C-1 could not be surface initiated by the impact of explosively driven high-velocity glass particles; the shock wave penetration velocity in open pore polyester foam of 2 lb/ft^3 density was determined; the polyester foam (density = 2 lb/ft^3) is compressed and forced ahead of the shock wave; the configuration of the plastic foam attenuator, to obtain simultaneous impact of the shock wave with the buffer plate, was graphically determined; and theoretical studies were performed to determine the shape, position, and hydrodynamic parameters of the various waves in the buffer and flyer plates as well as the shape of the buffer and flyer plates required to impart a cosine distributed shock impulse to a cylindrical target, using a flyer plate. (auth)

23806 (SCL-CR-67-167) CONVERSATIONAL APT: A REPORT ON THE FEASIBILITY OF IMPLEMENTING APT AS AN ON-LINE INTERACTIVE SYSTEM. Final Report. Horning, D. B. (Control Data Corp., Palo Alto, Calif.). Apr. 1967. Contract AT(29-1)-789. 101p. Dep. CFSTI.

For Sandia Corp., Livermore, Calif.

The feasibility of implementing APT III in conversational mode on a Control Data Corporation 3600/3800 computer. Topics include design objectives, conversational design, reference specifications, the whole system, the APT manager (APTMGR), flow of information through the conversational APT complex, the APT execution complex, editing complex, retrieval and control complex, and system implementation. (B.G.D.)

23807 (SCL-RR-66-97) EQUILIBRIUM COMPOSITION AND SHOCK-WAVE CHARACTERISTICS OF FREON C-318. Emery, A. F. (Sandia Corp., Livermore, Calif. Washington Univ., Seattle). Mar. 1967. Contract AT(29-1)-789. 70p. Dep. mn. CFSTI $3.00 cy, $0.65 mn.

A discussion of the theoretical behavior of Freon C-318 in an aerodynamic shock tube with a stationary test model is based on an equilibrium composition determined by numerical calculations. Pressure calculations indicate that the ideal gas-flow properties would be very little affected by the decomposition of the gas which occurs behind the shock wave. (auth)

23808 (UCID-15100) DETERMINATION OF TRACE CHLORINE IN FLUOROELASTOMERS. General Chemistry Technical Note No. 237. Lim, Robert (California Univ., Livermore. Lawrence Radiation Lab.). Apr. 4, 1967. Contract W-7405-eng-48. 6p. Dep. mn. CFSTI $3.00 cy, $0.65 mn.

A method for determining trace chlorine in fluoroelastomers is presented. The fluoroelastomer, with paraffin added as fuel, was burned in a platinum-lined oxygen bomb containing sodium hydroxide absorbing solution. This solution was then titrated with mercuric nitrate, with s-diphenylcarbazone used as the indicator. (auth)

23809 (UCID-15109) EXPERIMENTAL STUDIES ON THE ADSORPTION OF MOLECULAR IODINE ON SOOT. Ackerman, F. J.; Kay, C. (California Univ., Livermore. Lawrence Radiation Lab.). Feb. 9, 1967. Contract W-7405-eng-48. 15p. Dep. mn. CFSTI $3.00 cy, $0.65 mn.

Measurements were made of the adsorption of airborne molecular iodine on soot produced by burning acetylene, latex tubing, and automobile tire rubber. Soot from latex tubing and rubber tires adsorbed approximately 90% of the iodine over a wide range of soot and iodine concentrations when the contact time was 0.6 minutes or greater and the I_2/soot ratio was less than 0.0062 gram/gram. (auth)

23810 (UCRL-50219) PROCEDURE FOR INTERPOLATING BIVARIANT DATA INFLUENCED BY RANDOM ERROR. Van Sant, J. H. (California Univ., Livermore. Lawrence Radiation Lab.). Mar. 31, 1967. Contract W-7405-eng-48. 12p. Dep. CFSTI.

Suppose there exists a table of data (X_j, Y_j), $j = 1, 2, \ldots$, in which the dependent variable is in part probabilistic (i.e., it contains some random error). The symbol X is referred to as the independent variable and the symbol Y as the variable dependent on X. Let X^* be the value of X at which it is desired to estimate a value of Y to be called Y^*. A method for determining Y^* from an optimum number of local data points is described. (B.G.D.)

23811 INTERNATIONAL COOPERATION IN STANDARDIZATION OF IONIZING RADIATIONS UNDER THE AUSPICES OF THE INTERNATIONAL BUREAU OF WEIGHTS AND MEASURES. Yura, Osamu. Denki Shikensho Iho, 30: 1035-40(Dec. 1966). (In Japanese).

An outline of the cooperative activities internationally performed in the field of the standardization of ionizing radiation during the last decade is given based on the reports of the Consultative Committee for the Standards of Measurement of Ionizing Radiations presented to the International Committee of Weights and Measures. (tr-auth)